ERIC Document Resume | See Instruction Sheet | DATE OF RESUME 7/7/65 | DATE RECEIVED

A. PUBLICATION DATA

1. ERIC NUMBER ED000931

2. ORIGINATOR CONTROL NO(S). 8582

3. IDENTIFICATION NO. CR E-3

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MICROFILM COPY AVAILABLE YES ☒ NO ☐

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TYPE OF REPORT
PROPOSAL ☐
IN-PROGRESS ☐
FINAL ☒
FOLLOW-UP ☐

OTHER ERIC REFERENCES:

ERIC SATELLITE CODE

4. AUTHOR(S): Stein, Morris I.

5. TITLE OF DOCUMENT ABSTRACTED: Survey of the Psychological Literature in the Area of Creativity With a View Toward Needed Research (Cooperative Research Project E-3)

6. PUBLICATION TITLE: N.A.

7. EDITOR(S): N.A.

8. PLACE OF ORIGIN
New York Univ.
Washington Square
New York, New York
CITY, STATE
TELE. EXT.
INST/LCC CODE

9. PUBLISHER OR SOURCE New York University

10. VOL. N.A.

11. PAGES N.A.

12. MO./YR. 62

13. TOTAL PP. 99

B. INDEXING DATA

14. SUBJECT AREA

15. TYPE OF ENDEAVOR survey

16. INDEXING TERMS (6-12)

		problem-solving P-18A
surveys Y-18A	research P-37	characteristics R-43
Cooperative research R-35	students Y-15	personality P-08
creativity R-39	intelligence S-19	

17. ABSTRACT (MAX. 250 WORDS)

Concentrates on three particular areas of research into the nature of creativity: (1) The choice of criteria, (2) cognitive characteristics (intelligence, imagery, perception, problem-solving), and (3) personality characteristics. The author states that the resolution of the problem of understanding creativity will require a multi-dimensional approach in which both psychological and social factors, broadly considered, will play a significant role.

The report has three major objectives: To highlight existing approaches to the study of creativity, to explicate the strengths and weaknesses of these approaches, and to project possible approaches for new research endeavors.

Lists 100 titles on systematic empirical research.

ERIC No. 18. SOURCE OF ABSTRACT

C. FUNDING DATA

19. SUPPORTING ORGANIZATION

20. DIVISION OR DEPT.

21. CONTRACT NO.

PROJECT NO.

22. TOTAL COST OF PROJECT

23. DURATION OR PROJECT

U.S. Department of Health,
Education, and Welfare
Office of Education

ERIC Form 1

SURVEY OF THE PSYCHOLOGICAL LITERATURE IN THE AREA OF CREATIVITY WITH A VIEW TOWARD NEEDED RESEARCH

COOPERATIVE RESEARCH PROJECT NO. E-3

MORRIS I. STEIN

U. S. DEPARTMENT OF HEALTH, EDUCATION AND WELFARE
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RESEARCH CENTER FOR HUMAN RELATIONS
NEW YORK UNIVERSITY

ED000931

SUMMARY

Title: SURVEY OF THE PSYCHOLOGICAL LITERATURE IN THE AREA OF CREATIVITY WITH A VIEW TOWARD NEEDED RESEARCH

Investigator: Morris I. Stein

Institution: Research Center for Human Relations
New York University
New York, New York

Project Number: E-3

Duration: September 1, 1961 to August 31, 1962

BACKGROUND

The capacity to create and develop novel solutions to old existing problems is one of man's most critical capacities. It has attracted attention from time immemorial. Within the past decade or so these efforts have been intensified. They aim at understanding the creative process and the creative individual. In addition, they aim at the early identifying of individuals with creative capacities so they might be selected for situations in which they could fulfill themselves and so contribute to the benefit of society. Knowledge of the creative process and the creative individual might also be helpful in learning how to stimulate the capacities of others and to remove the obstacles that limit the contributions they might make.

The problem is a complex one and will require the efforts of many researchers. To aid them in their work, a review of the literature was undertaken. The review does not survey all the factors that have been studied in relation to creativity. Rather, it has concentrated on three areas: the criterion problem, the area of cognitive characteristics and the area of personality characteristics.

OBJECTIVES

The objectives of this research were:

1. To highlight existing approaches to the problems in this area.
2. To explicate the strengths and weaknesses of these approaches.
3. To project possible approaches for new research endeavors.

PROCEDURE AND RESULTS

The Criterion Problem

In surveying the literature we find that the following criteria have been used in selecting individuals for studies of creativity: generally acknowledged creativity, secondary sources, judgments of peers and raters, quantity of novel products and psychometric approaches.

By "generally acknowledged creativity" we refer to those studies in which individuals have been selected who would be regarded as creative by almost all people--e.g., Michaelangelo, da Vinci, Shakespeare, and Einstein. When this approach is used the investigative technique is the case study. It results in much understanding of the individual as well as in the development of many hypotheses that need to be investigated further in a systematic study of large numbers of individuals. This approach also yields no guideposts for selecting groups of individuals for other studies.

The second approach to identifying creative persons is to consult various secondary sources (biographies, dictionairies, etc.) to develop an initial population. Then a second criterion (e.g., number of pages devoted to the individual, dissemination of works) is utilized to differentiate among those in the initial group. It might be argued that these sources are good ones for selecting creative persons since the individuals included in biographies and dictionairies have stood the test of time. However, one must also be aware of the possibility that biographers might either exaggerate or gloss over details. Secondly, an individual's characteristics, by the time he has achieved a position when his biography is written, are not necessarily those he possessed while he was engaged in creative activity. Thirdly, while individuals included in major works may be eminent, there is no assurance that they were also creative. Finally, one needs to consider carefully the criteria used by writers and editors to judge the possibility of any systematic bias.

The third criterion used in selecting creative individuals is the judgments of experts in a specific field and the use of ratings. If global ratings are used there is the possibility that they are based on one primary characteristic such as number of publications and if so this needs to be made explicit. Other factors such as personal liking, the "halo effect" might also be operating.

A fourth criterion that has been utilized is the quantity of novel products an individual produced. It has been most effectively used with inventors who take out patents. Thus, implicitly, they had to fulfill the standards of novelty set by the Patent Office. This approach might not be applicable in other areas where such implicit standards are utilized.

The last approach to the criterion problem is the psychometric approach in which the psychologist selects "creative" or "original" subjects on the basis of test scores that indicate that the subject is capable of both novel and adaptive responses. The psychometric approach is regarded as more "objective" than some of the other approaches which are more "social" in orientation (e.g., judgment of experts) and which therefore contain many evaluational difficulties. But, psychometric definitions are psychologists' definitions and in this sense are no less social. While this approach may find the individual who is "psychometrically creative" in the psychologist's laboratory there is no assurance that these individuals will be manifestly creative in the broader society because it does not take into consideration the effects of environmental and chance factors on creativity.

All criteria used may be criticized in one way or another. There is a search for "ultimate criteria." Until these are found, all the investigator can do is to select some reasonable criterion. In doing so, however, he must bear in mind that he is studying individuals who can fulfill certain requirements or who can achieve a certain "standard of performance." And the various characteristics of the different standards of performance need to be clearly indicated. When this is done and the characteristics of individuals who can fulfill different standards are integrated, we may further our knowledge about the conditions under which various types of individuals may fulfill their potentialities and be regarded as creative.

Cognitive Characteristics

The research literature on the relationships between creativity and the following cognitive characteristics was surveyed: intelligence, imagery, perception, and problem-solving.

Our survey indicated that insofar as intelligence was concerned it has been studied both as an independent and dependent variable. Both approaches indicate that while intelligence and creativity may be related in the general population in the sense that below a certain intelligence level creative people are not found, high intelligence alone is no guarantee of creativity. In addition to intelligence the individual needs to possess certain personality and motivational characteristics which we shall discuss later as well as the opportunity to demonstrate and manifest his creativity.

With regard to imagery we find that the evidence in this area is largely anecdotal; however, systematic research indicates that it is related to vocational choice. Other than indicating the presence of certain types of imagery in creative individuals, there are no studies in which control groups were used so that the critical nature of the relationship between creativity and imagery is still rather unclear.

The perceptual literature in the area of creativity may be divided into two groups. One concerns itself with the subject's perceptual processes and the other with his preferences for various forms. Process studies indicate that creative individuals are more capable of integrated percepts and freer in suggesting hypotheses for poorly structured stimuli than are their less creative counterparts. Those studies concerned with the preference for visual forms have indicated that the more creative subjects show more preference for physiognomic percepts and complex forms. Where these perceptual data have been related to personality factors it has been suggested that the more creative individuals are less defensive and less self-critical and take greater satisfaction in making order out of complexity than their less creative colleagues.

Investigators in the area of creativity have also shown a great deal of interest in their subjects' thought processes and problem-solving capacities. A variety of procedures and theoretical orientations have been used. They include factor-analytic studies, experimental situations, and attempts to develop specially designed tests. In terms of theory they include associationism, Gestalt theory and psychoanalytic theory. Associative fluency, remoteness of association, and process characteristics are among the variety of factors that have been positively related to creativity. When significantly differentiating factors are reported they are consistent with other data and they also make intuitive sense. However, there are several instances where replication has not supported earlier results and one is at a loss for a well-defined rationale. To be sure, it is not difficult to suggest reasons why results have not been replicated--*e.g.*, differences in criteria, differences in subjects, etc. But these are only possibilities. They require further investigation so that we might learn more about the *conditions* under which certain tests or factors do or do not differentiate between subjects and the circumstances under which certain characteristics are important.

It is also pointed out that one must bear in mind that the individual is a combination of both intellectual and non-intellectual factors, personality and cognitive characteristics. Consequently, when low or moderate correlations are obtained between tests developed in the laboratory and some criterion of creativity for individuals who are manifestly creative in real situations, it is likely that the residual variance may be accounted for by personality and social factors that require further investigation.

Personality Factors

Studies of personality factors associated with creativity in the empirical research we surveyed have involved at least three major criteria for selecting subjects: psychometric definitions, productive measures and expert judgments. The techniques employed in the studies included objective tests, projective tests, questionnaires and interviews. And, the subjects studied have come from a variety of fields--the arts; the biological, physical and social sciences; and engineering. There is a great deal of diversity. Although the field is new and despite the diversity there are certain areas of agreement on the personality factors associated with creativity. In presenting these a good deal of liberty has been taken in grouping characteristics. They appear to be psychodynamically similar. It must also be borne in mind that the attempt here is not to present a picture of the creative individual. Evidence is already available which indicates that there may be more than one type of creative person.

With these cautions in mind, the following characteristics have been pointed out by several investigators; when there are data which disagree they are so indicated. The statements are made in terms of the characteristics of the creative individual.

1. Self-assertive, dominant, leading, initiative, aggressive, self-sufficient.

2. Rejects repression, less inhibited, less formal, less conventional, bohemianly unconcerned, radical, low authoritarian values. One investigator reports they are not "bohemian."

3. Persistence of motive, liking and capacity for work, self-discipline, perserverance, high energy output, thorough.

4. Independence and autonomy. These characteristics were not reported as found among engineers.

5. Constructively critical, less contented, dissatisfied.

6. Widely informed, wide-ranging interests, versatility.

7. Openness to feelings and emotions, feeling more important than thinking, more subjective, vitality and enthusiasm.

8. Aesthetic intelligence, aesthetic judgment, high or higher aesthetic values. Aesthetic sensitivity was not found to differentiate among engineers.

9. Low economic values, poor business man. It has been reported, however, that "more" creative industrial research chemists have higher economic values than do their less creative colleagues.

10. Freer expression of what has been called feminine interests and lack of masculine aggressiveness.

11. Little interest in interpersonal relationships, do not want much social interaction, introverted, lower on social values, reserved.

12. Emotionally unstable but capable of using their instability effectively, not well adjusted by psychological definition but adjusted in the broader sense of being socially useful and happy in work. It has also been suggested that creative persons are not unstable.

One of the problems hampering research in this area is the lack of agreement on a systematic set of personality variables. Another problem is that research is based on known professional or scientific groups rather than on the structural aspects of the field in which the individual is working. It is suggested that a concreteness-abstractness dimension may help in this regard; or, the degree to which an individual might be able to explore his own interests. Since creativity is a function of the transactional relationships between an individual and his environment, the meaningfulness of personality factors related to creativity will probably be better discerned when we also have a set of dimensions for describing the environment.

Another area of further research is the investigation of the types of individuals who are and are not creative. Theoretically different personality constellations may lead to the same end-state and these should be discerned in the data. Finally, the need for predictive studies is pointed out. Currently, most studies are based on known groups and, in such studies, it is impossible to discern the effects of having been creative or not having been creative on the individual's personality. Predictive studies might also bring to light the importance of the transaction between personality factors and social factors.

CONCLUSIONS AND IMPLICATIONS

The time is now ripe for a coordinated and cooperative research effort by problem-oriented researchers. Unless such a program is undertaken there will be a proliferation of studies and techniques but no integration of knowledge and no necessary increment in our ability to prodict who those individuals will be who make future creative contributions.

In this program a group of investigators would assemble for a period of years and select groups of individuals in a variety of areas for study. These individuals would come from a variety of organizational settings and would be selected in terms of diverse criteria. To these groups the investigators would administer a core battery of tests that they would all decide upon. This battery would include measures of cognitive, personality, biographical, and environmental characteristics. In addition, allowance would be made for the "pet" ideas or tests that are congenial only to individual investigators.

While each investigator might concern himself only with some set of variables or some special problems, the pooling of information would help resolve many basic issues. It would further our knowledge of the conditions under which certain variables are more critical than others. We might also find that different patterns of variables are related to different types of work, styles of creativity or aspects of the creative process. We might learn more about the relationships between laboratory experiments on creativity and those studies that concentrate on individuals who are manifestly creative in the outside world. Follow-up studies of such individuals would also help clarify the importance of both psychological and social factors related to creativity.

This plan may sound overwhelming but there are several group endeavors on the scene at the present time that could serve as models if not the nucleus of such an undertaking. While there would no doubt be problems it is likely that such a coordinated cooperative effort would go far in furthering our understanding of an aspect of human behavior which is so critical for the individual and society.

BIBLIOGRAPHY

There are 101 references listed in the final report.

SURVEY OF THE PSYCHOLOGICAL LITERATURE IN THE AREA OF CREATIVITY WITH A VIEW TOWARD NEEDED RESEARCH

Cooperative Research Project No. E-3

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Research Center for Human Relations
New York University
New York, N. Y.
1962

The research reported herein was supported through the Cooperative Research Program of the Office of Education, U. S. Department of Health, Education, and Welfare.

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Introduction

The capacity to create and develop novel solutions to old or existing problems is one of man's most critical capacities. Efforts to understand it and the individuals who possess it have been underway since time immemorial. Within the past decade or so these efforts have been intensified, especially by psychologists who have sought to investigate the problem systematically. Their aims have been not only to understand the creative process and creative individuals and so contribute to the basic knowledge of human behavior but also to identify individuals with creative capacities, hopefully as early as possible, so they might be selected for situations in which they could fulfill themselves and so contribute to the benefit of society. With knowledge so gained, it might also be possible to learn how to stimulate the latent potentialities of others and to remove the obstacles in their pathways so they too may make significant contributions.

The problem is a complex one. To solve it will require the efforts of many researchers. To aid them in their efforts and to make it easier for them to profit from others' experiences this review of the literature was undertaken. The goal was not to review all the factors that have been studied in relation to the problem -- age, nervous system, heredity, the data contained in the sociological or anthropological literature or the theories of the creative individual's motivational system, some of which have previously been reviewed by Stein and Heinze (1960). Rather, the goal has been to concentrate on three areas: the criterion problem, the area of cognitive characteristics and the area of personality characteristics. It is important to state the limits of this review at the outset for it is likely that resolution of the problem will require a multidimensional approach in which both psychological and social factors, broadly considered, will play significant roles.

With this caution in mind the objectives of this paper are three:

1. To highlight existing approaches to the problems in this area.
2. To explicate the strengths and weaknesses of these approaches.
3. To project possible approaches for new research endeavors.

Chapter I

The Criterion Problem

What are the criteria involved in selecting individuals for studies of creativity? A survey of the literature indicates that the major procedures have been: generally acknowledged creativity, secondary sources, judgments of peers and raters, quantity of novel products produced and psychometric approaches.

Generally Acknowledged Creativity

The name of this category may not be completely appropriate for it overlaps with the category that follows. Nevertheless, what is intended by the phrase "generally acknowledged creativity" is that the individuals selected for study, e.g. Michaelangelo, DaVinci, Shakespeare, Einstein, would probably be accepted as creative by almost all people. When this procedure is used the investigative technique is that of the case study as we find in the work of Wertheimer on Einstein (Wertheimer, 1945). This approach results in much understanding of an individual as well as in many hypotheses that need to be investigated in further systematic studies of large numbers of individuals.

Secondary Sources

The second approach to identifying creative persons is to consult various secondary sources to develop an initial population. Then a second criterion is imposed to differentiate among those in the initial group.

Galton for his work on Hereditary Genius (Galton, 1870) selected his subjects from different fields and secondary sources related to them. The English judges he studied came from the Lives of the Judges by Foss and from these he selected only those who lived between 1660 and 1865.

His statesmen were premiers beginning with the reign of George III and the men mentioned in Lord Brougham's Statesmen of the Reign of George III. Although he gives no source for his commanders, he says that he included only those "whose reputation has been tested by prolonged wars, or whose ascendancy over others has been freely acknowledged." His literary men came from "dictionaries" and then only those who were "most prominent." Scientists were selected from biographical dictionaries--men of "enduring reputation" or "otherwise well known" to their generation. The divines came from Middleton's Biographia Evangelica. Galton does not give the sources for his poets, musicians or artists.

Using these sources Galton then distinguished three grades of ability: (a) Illustrious men--among whom "many are as one in a million, and not a few as one of many millions....They are men whom the whole intelligent part of the nation mourns when they die; who have, or deserve to have, a public funeral; and who rank in future ages as historical characters." (b) Eminent men--individuals who "achieved a position that is attained by only 250 persons in each million of men, or by one person in each 4,000." (c) The third or lower grade was that of English judges--their average ability "cannot be rated as equal to that of the lower of the two grades" described above.

In a later study of English men of science, Galton (1874) selected his subjects from among the Fellows of the Royal Society. In addition they had to have one or more of the following qualifications: a medal for scientific work, presidency of a learned society or a section of the British Association, membership on the council of the Royal Society, and/or a professorship in some important college or university. Only in two or three cases were deviations from these criteria allowed.

Cattell (1903) selected his eminent men from six biographical dictionaries and retained only those who appeared in three sources and who had the greatest space devoted to them. Cora Sutton Castle (1913) followed a similar approach in her study of eminent women.

British genius was studied by Ellis (1904) by selecting names from the Dictionary of National Biography. But he concentrated only on those in whom the qualities of intellectual ability were most essential. While he generally limited himself to persons who had three or more pages allotted to them, Ellis did not follow his rule rigidly. If a biographer considered his subject to possess intellectual ability of a high order and discussed his subject in less than three pages, he was included in the study. Similarly, if an individual had more than three pages devoted to him but he was not described as possessing high intellectual ability, he was excluded. Over 300 biographies and other sources of information were also consulted.

Clark (1916) for his study of American men of letters reviewed five encyclopedias of American biographies and other supplemental works. He then limited himself to those who were born before 1851 in the United States or Canada, lived in a home in which English was spoken and who did their work in English. For the writers in his group the criterion for success was diffusion of works. Actors, orators, patrons and librarians were selected on the basis of an estimate of the extent to which they had affected their contemporaries. Clark also drew a distinction between men of talent and men of merit. Among the writers who were men of merit, additional criteria were used: number of translations, popularity in English, and the extent of posthumous publication. For actors, patrons, orators and librarians, posthumous reputation was the sole criterion.

Lehman combined a secondary source plus expert opinion. For his work on Age and Achievement (Lehman, 1953) he submitted Hilditch's A Concise History of Chemistry to four university teachers of chemistry for evaluation. A similar method was used to select mathematicians. Published expert opinion was consulted for literature, philosophy, education and painting.

Judgments of Experts

In contemporary research one finds it more common that investigators have obtained judgments from individuals who are experts in their field and who are qualified to make judgments about others.

Cattell (1906) for his study of outstanding scientists sent the names and addresses of "all those known to have carried on research work of any consequence" to "leading representatives" in their respective fields. These men were asked to rank-order the names on the basis of their contributions to the advancement of science. They were asked to emphasize research contributions (teaching, administration, editing, text book writing, etc. were also considered) to one field, disregarding contributions to other fields. Men for whom competent judgments could not be made were omitted. Ten sets of judgments were made for each science. The judgments were then averaged, the probable error of the rank was calculated, and scientists from different areas combined into one list.

Roe (1951a)in her study of eminent biologists selected them from the National Academy of Sciences and/or the American Philosophical Society, on the basis of ratings by six men chosen to represent all the subdivisions of biology. Three of the men were not members of these societies, but were suggested as highly qualified by at least two raters. Roe had eliminated from her work all those who were foreign-born, over sixty, and not actively engaged in research at the time of her study. For her study of psychologists and anthropologists Roe (1953) used judgments of peers.

Stein (1956) began his study of more and less creative researchers in industry hoping to use patents and publications as criteria. However, he soon learned that these possible criteria had several deficiencies. In some instances a company might refuse to have a patent or publication appear due to problems of competition. On other occasions to avoid problems of authorship several names would be listed on a paper. They were not necessarily the names of all the people who did the work and on some occasions they might include names of individuals who made minimal contributions. Furthermore, particularly with regard to patents, one had to be aware of the "patent hound"--the researcher who studies published patents, develops some variation and obtains a new patent. Consequently, Stein, too, used "expert" judgments but in this instance the judgments of people who had worked with his subjects over a period of time. Ratings were obtained from superiors, colleagues, and subordinates. Superiors were used as raters on the assumption that they had a broad overview of all their personnel, much experience with researchers, and therefore could make comparative judgments. However, since superiors were at a "distance" from the man, judgments were also obtained from a man's colleagues on the assumption that they were closer to on-going developments in their field and even if they were competitive their competitiveness would make them "hard-headed" in their evaluations. Finally, judgments were also obtained from a man's subordinates on the assumption that they, of all the evaluators, were closest to the man and his work, knew how the work originated and who was responsible for carrying it out. After judgments were obtained from all three groups of evaluators their reliability was studied and only those men on whom the judges agreed were retained for further study.

Quantity of Works Produced

A fourth criterion that has been utilized is the quantity of novel products that an individual has produced. Rossman (1931) used the number of patents issued as a criterion in his study of inventors and then obtained information from inventors themselves as well as people associated with them--patent attorneys, directors of research and development organizations.

Psychometric Approaches

The studies that fall into the three main criteria sections discussed above are those which involve the investigation of characteristics of individuals who have been manifestly creative in real social situations. But another area in creativity research is devoted to the study of individuals who meet the criterion set up by the psychologist in the laboratory. Either the study is concerned with basic issues involved in creative thinking or it is concerned with personality correlates of criteria of "originality" developed by the psychologist. The subjects who are studied in such investigations may or may not have been manifestly creative.

Guilford (1959a),for example, studies individuals who are not distinguished in terms of any independent criterion of creativity. Among others he has studied Coast Guardsmen or "high-level" personnel. To such groups a battery of psychological tests is administered and the relationships between test scores is studied using factor analytic procedures. On the basis of such statistical analyses purer and purer factors are defined and tests constructed to obtain measures of these factors. This approach yields significant insights into the factors involved in creative thinking as well as tests that may be used in studies of manifestly creative individuals as we shall see in our later discussion.

The group of investigators at the Institute for Personality Assessment and Research (IPAR) at the University of California at Berkeley have used an approach similar to that employed by Guilford. In some of their studies (e.g. Barron, 1955, 1957) where they have been concerned with "originality" and its personality correlates emphasis was placed on the extent to which the individual deviates from a norm or the infrequency of his response among a population of responses. Deviation and infrequency were not the sole criteria for in addition the subject's response had to be adaptive to reality. Again subjects need not be manifestly creative but a group of 100 captains in the United States Air Force who are described as "a group of normal, healthy young men of average intelligence, socio-economically of the lower middle class in their pre-military background, and similar to young men in general" in their performance on tests used in the experiment (Barron, 1955).

Studies of creativity are then based on individuals selected in a variety of ways--individuals whose accomplishments are so outstanding that no one would quarrel with their selection, secondary sources plus some means of differentiating among persons, judgments of experts, quantity of productions, and psychometric definitions. There is no one approach that would meet with everyone's satisfaction and those presented above may be subject to various criticisms.

One cannot question very much the procedure of selecting individuals who have been extremely outstanding. There are few, if any, persons who would deny that an Einstein, a Michaelangelo or a DaVinci were creative. The only problem is that such investigations are limited to the one or two cases studied. While they may yield critical hypotheses or insights that may be useful in other investigations to illuminate the factors involved in or related to creativity, they provide no guideposts for selecting groups of individuals in other studies.

With regard to the use of dictionaries, biographies and encyclopedias and other published secondary sources, it might be argued that these are reasonable sources because the individuals included in them have stood the test of time. However, several questions might be raised regarding these sources. Biographers might become so involved with the persons about whom they are writing that they might tend to gloss over some details while exaggerating others. Secondly, characteristics descriptive of an individual by the time he has achieved a position when a biography is written about him or he is included in an encyclopedia are not necessarily those he possessed while he was in the midst of his creative activities. Thirdly, while individuals included in major works may be regarded as eminent, one may raise the question whether they were also creative. Stating the problem differently, one may ask whether these individuals were not simply "popular" or "visible" and factors associated with popularity and visibility may or may not be associated with creativity. Finally, one needs to consider carefully criteria used by writers and editors in compiling their histories and encyclopedias. It would be well to know their criteria for assigning a certain amount of space to an individual and it would be well to know whether any systematic bias was involved in their work.

On this last point some empirical data are available. Dennis (1956) suggested that, "It is possible that biographies, histories, and lists of best works contain systematic errors somewhat favoring a man's early work at the expense of his later products...." In some instances there may be preferences for citing a man's early, rather than his later, work; recent contributions are more difficult to evaluate than earlier ones; standards of evaluation vary during the course of a man's work; and the judgment of quality is also complicated by the great increase in the number of workers in various fields.

To investigate his hypothesis that some works "may show a bias in favor of citing works done in early historical periods as compared to later periods of time," Dennis (1958) used the following procedure. First he estimated the world's total scientific output for each decade between

1800 and 1900 (based on a sample of data contained in the catalogue of the Royal Society of London). He then determined what proportion of the total output in each decade had been cited in source books in biology, chemistry, geology, physiology, and physics. This analysis indicated that the "likelihood of a paper published at the close of the century being included in a source book was only one-tenth of the value of the comparable figure for the first decade of the century." The ratio between the likelihood that a paper written in the first decade of the century will be cited, and the likelihood that one written in the last decade will be cited, varied for the different branches of science. A study of citation practices from 1900 to 1949 confirmed the results for the nineteenth century. Dennis concludes his study by saying that, "if in the course of his professional lifetime a man's output remained approximately constant in quantity and quality and if citation of his works followed the time trends of his field, a tabulation of the frequency of citation of his works according to his age, would give the impression of a marked decrement in the amount of high quality work in his later years. A more reasonable interpretation of the facts seems to be that, as the total output of science has increased, the percentage of literature cited by histories was a declining percentage. This is due to the limitations of the historians and to the limitations of book size rather than to age changes in scientists."

The third approach we considered, evaluation by experts, is based on the assumption that they should know the status of their fields and should be in a position to know which are the creative developments. It is also a feasible approach when one wishes to study individuals who are currently engaged in creative activities. Global ratings of creativity, however, are likely to overlook some of the specific factors that enter into the judges' evaluations. Harmon (1958) reports a study designed to investigate the determinants of judges' ratings on creativity. He asked judges to rate the creativity of 1949 applicants for AEC fellowships on the basis of questionnaires that the applicants filled out.

The questionnaire included questions related to: (a) educational experience since 1949, (b) present job, (c) other occupational and military experiences, (d) patents, granted and applied for, (e) publications, (f) scientific and technical society membership, (g) best scientific and technical accomplishments, etc.

Each questionnaire was evaluated as a whole and the respondent rated on creativity by "experts in the field." Harmon then analyzed the data and found that number of publications was essentially the main criterion used by the judges.

Questions may also be raised regarding the effects of liking and the effect of interpersonal relationships and other "halo phenomena" when ratings are used. These might result in over- as well as under-estimations of a man's creativity. The fact that one uses experts as judges does not necessarily mean that they are going to be unbiased because their status position is not threatened. There are instances in the history of science where the scientific community itself was most vocal in its criticism of developments when first presented and it was only later that these developments were accepted as creative accomplishments.

Basically, studies that use secondary sources or expert ratings have been criticized because in the final analysis they are "social" definitions of creativity based on human judgments and these may be subject to all kinds of evaluational problems. In responding to these criticisms, Galton (1870) said, "I feel convinced that no man can achieve a very high reputation without being gifted with very high abilities; and I trust that reason has been given for the belief, that few who possess these very high abilities can fail in achieving eminence." Cattell (1906) agreed that judges' evaluations were subject to a variety of errors but said that, "There is, however, no other criterion of a man's work than the estimation in which it is held by those competent to judge." Furthermore, by using judgments from several sources it is felt that some of the systematic errors may be avoided.

The psychometric approach is more "objective" than the others described. The criteria it utilizes are operationally defined and techniques for gathering information are carefully specified. But despite these considerations which may give the impression that social judgments have been avoided, it must be borne in mind that the source for the psychologist's ideas often lie in studies of creative individuals who have been selected in terms of criteria described above. Psychometric definitions are psychologists' definitions. They may define the creative individual as he appears in the psychologist's laboratory and in terms of the psychologist's variables but there is no assurance that the individual who is creative under these circumstances will be manifestly creative in society. The psychometric definition does not investigate the critical effects of social or sociological factors.

Terman and Oden (1947) in a follow-up study on intellectually gifted students pointed out that, while the members of the group by the time they were 35 had published 90 books or monographs and approximately 1,500 articles in scientific, scholarly, or literary magazines, the group contained no one who manifested the promise of equalling Shakespeare, Goethe, Tolstoy, etc. This the investigators attribute to the fact that "such eminence in a given field is usually possible only at a given stage of cultural progress and can never be closely paralleled in a different era. For one thing, science and scholarship are growing so highly specialized that eminence is becoming progressively more difficult to attain." Furthermore, much depends on "chance and circumstance."

It is apparent that all of the criteria presented above might be criticized in one way or another. Most of the criticism is based on the fact that subjectivity of judgment may be involved and consequently there is the constant desire for "ultimate criteria" or "objective criteria." If such criteria were available they could be applied to all persons and one would then not overlook those individuals who are not "popular," visible or in favor with the judges or the compilers of bibliographies. It would also be possible to have a metric for differentiating between individuals of different levels of creativity. Toward this end McPherson (1956) suggested, as a starting point, the investigation of the factors involved in the granting of patents. He points out that, "According to the law, one who originates novel technology has the right to obtain a patent only if the 'quantum of novelty claimed rises to inventivlevel.'" McPherson also indicates that among the legal criteria used are: "creative strength," the overcoming of some special difficulty, prior failure, prior skepticism, a decided rise in business following the introduction of the product, the presence of an unfulfilled desire which the patent fulfilled, etc. Although there are difficulties with all these evaluations McPherson believes that using this information as a starting point some analytic scheme could be developed for the judgment of creativity. To develop such a scheme would involve the cooperation of scientists and psychologists. At the moment, it might be said that if such a scheme could be developed it would more likely occur in the sciences rather than the arts.

There is another way of approaching the criterion problem. It may be said that all of the approaches described above involve not criteria of creativity but rather indications or acknowledgements that the individuals studied have achieved certain "standards of performance" (Stern, Stein, and Bloom, 1956). Thus all studies of creativity are studies of individuals who are regarded or reputed to be creative because they fulfill certain conditions. When an individual is selected from a bibliography or in terms of expert judgments, one is saying that he has in some way met the requirements of individuals who make these judgments. When an individual is selected in terms of patents then he has met the requirements of those who grant patents. In research oriented to investigating the psychological characteristics of creative individuals, the critical problem is to determine whether the characteristics of individuals fulfilling certain standards of performance are similar to or different from those who fulfill different standards of performance. Is the individual who is selected from a compilation of eminent individuals psychologically similar to or different from individuals regarded as creative by their peers? Only as we gather data on these similarities and differences will we be in a position to learn the extent to which differences in criteria actually do make a difference insofar as the psychological characteristics of the individual are concerned.

Using the approach just suggested it is also possible to better integrate the psychometric criteria and the selection of manifestly creative individuals as well as to differentiate between two major roles of the psychologist in this area. When the psychologist studies individuals who are manifestly creative he does not participate in setting up the requirements although he may analyze the judgments to determine the specific factors that are involved. His role is a more active one when he sets up his own definitions. Now, it may well be that the whole array of psychological characteristics of individuals who fulfill the one set of criteria may be different in certain respects from the array that characterizes individuals who fulfill the other set. It would then appear that it would be incumbent upon the psychologist, who has selected individuals in terms of his own psychological criteria, to investigate how his subjects will compare with the others either in laboratory or real life conditions. Through such investigations new insights and new hypotheses worthy of further investigation are likely to be revealed.

Basically, the value of differentiating between a criterion and a standard of performance is that it calls attention to the fact that we are studying a phenomenon that may vary under different conditions.

One additional comment needs to be made regarding the criterion problem. In almost all studies of creativity subjects are selected in terms of the products they have produced and the extent to which these products deviate from that which has existed. It therefore, in one sense, would be more rigorous to say that the studies are investigations of "innovators." Innovations, however, may be attained in a variety of ways--trial and error, serendipity, inventiveness, resourcefulness, as well as through the creative process. The creative process appears to involve more "inspiration" than the other processes and compared to them it involves a greater leap into the unknown. Ghiselin (1958) in distinguishing between creativity and inventiveness and resourcefulness says that the latter requires little thinking to reach a solution, and the intelligent use of previous experience and knowledge is necessary but nothing more. He also distinguishes between two levels of creativity. Creative action of the higher sort, he says, alters "the universe of meaning by introducing into it some new element of meaning or some new order of significance." It occurs, more commonly, when someone feels that the old universe of meaning is inadequate. Creative action of the lower sort gives "further development to an established body of meaning through initiating some advance in its use." Consequently, it might be well if future research were oriented to investigating the psychological characteristics of individuals who follow different processes in developing their innovations or developing novelty. Without such consideration it is likely that some critical differences and characteristics may be obscured and overlooked.

In summary then, there does not appear to be any single "ideal" or "absolute" criterion of creativity that is presently available for all researchers. Efforts are in process to develop ultimate criteria and attention needs to be paid to process characteristics. While these efforts continue it seems feasible that investigators can do no more than select some reasonable criterion for their research. But having done so it is necessary that the specific factors involved in the criterion be spelled out so that research data might be compared. In this fashion and with the cooperative effort of many it is likely that a sufficient body of information could be accumulated from which it would be possible to infer those characteristics which an individual needs to possess if he is to be regarded as creative under a variety of conditions.

Chapter II

Cognitive Characteristics

Man may be described as a system of drives, a system of rewards and punishments, and a system of adaptive mechanisms. Our concern in this chapter is with some of the adaptive mechanisms--the individual's cognitive characteristics. Of these we shall focus on the relationships found between intelligence, imagery, perception, problem-solving and creativity.

Intelligence

As with most other variables in the area of creativity, intelligence has been studied both as an independent and dependent variable. Basically, the evidence from both approaches is that while intelligence may be related to creativity in the general population in the sense that below a certain level people are not creative, high intelligence alone is not a guarantee of creativity for it needs to be combined with certain personality characteristics.

The major effort in studying the characteristics of highly intelligent people is the monumental research of Terman and his associates (Terman, 1925; Burks, Barbara S., Jensen, Dortha W., and Terman, 1930; Terman and Oden, Melita, 1947; Terman 1954a; Terman, 1954b). While this series of studies was specifically concerned with the characteristics of the intellectually gifted it is considered here for the achievements of Terman's subjects might well have qualified a good number of them for studies of creativity.

Terman et al started with data collected on over 1400 children, each well within the top one per cent of unselected school populations of corresponding age. The initial report is based on a typical group of 643 children for whom data were most extensive and a second group of 309 for whom less extensive data were available. Control data were secured for 600 to 800 unselected children wherever possible. All children were from the public school system in California and they were mostly from the larger urban centers.

In selecting the main group of students the following procedure was used: (a) Teachers were asked to nominate from one to three pupils whom they regarded as most intelligent in their classes. Sources for procedures were also used, e.g., inquiries of teachers (especially those in lower grades), siblings of those already selected, casual information, accident, etc. (b) These pupils were then studied with the National Intelligence Scale B, Form I and those who scored at the 90th percentile (or as low as the 80th percentile in special cases, or among the younger children) were retained for further study. (c) Abbreviated forms (one for children of foreign parents and one for children of non-foreign parents) of the Stanford-Binet were administered. Students attaining an I.Q. of 125 or more (or 120 if they were older pupils) on the abbreviated scale were given a complete Stanford-Binet. On the complete Stanford-Binet those pupils below 11 years old who achieved an I.Q. of 140 and the older ones (13.5 to 14) who achieved an I.Q. of 132 (with appropriate decrements in I.Q. between these limits) were retained for the complete study.

The research then involved a rather intensive study of the pupils' interests, home background, physical status, anthropometric measurements and character and personality characteristics. In 1925 Terman reported that the gifted children scored decisively higher than control children in intellectual and social interests and did not differ materially in activity interests. A follow-up study two years later showed "that the gifted *children have not lost in educational or general ability, and that gains have far outbalanced losses with respect to such traits as social adaptability and breadth of interests."* And in 1930 (Burks, *et al*, 1930) this group was still achieving at high levels.

In the summary of the 1930 report Terman says, "It is to be hoped that the superstitions so commonly accepted relative to intellectually superior children have been permanently swept away by the factual data these studies have presented. It is simply not true that such children are especially prone to be puny, over-specialized in their abilities and interests, emotionally unstable, socially inadaptable, psychotic, and morally undependable; nor is it true that they usually deteriorate to the level of mediocrity as adult life is approached."

At the 25-year mark a comparison was made of subgroups ranked as the highest and lowest fifth of the entire group in success, defined as, "the extent to which a subject had made use of his superior intellectual ability." This comparison showed little difference between the groups in I.Q.; marked difference in the educational and occupational status of the family; no evidence of influence from such factors as age of parents, birth order or size of family; greater breadth of interests among "high" subjects; marked contrast in drive to succeed and in all-round social adjustment. Not until high school had the two groups shown marked differences in achievement, but by the end of high school the difference had become very marked. The highs had been more accelerated in school, and were favorable in opinion about acceleration.

When the subjects were close to 35 years of age (1945), the group had published 90 books or monographs and approximately 1500 articles which appeared in scientific, scholarly, or literary magazines. More than 100 patents were granted to the group, nearly half of these went to two men. The group, however, is not regarded as containing anyone who manifested the promise of equalling Shakespeare, Goethe, Tolstoy, etc. As indicated previously this is attributed to cultural developments and variations over the course of time.

In the 1954 report which was devoted solely to the scientists and non-scientists in his group, Terman says that, "their total contribution is many times the amount that could be expected from the same number of men picked at random in the general population" although no one in the group compares in status to those studied by Roe. On the basis of such data Terman concludes, "The follow-up of these gifted subjects has proved beyond question that tests of 'general intelligence,' given as early as six, eight, or ten years, tell a great deal about the ability to achieve either presently or 30 years hence. Such tests do not, however, enable us to predict what direction the achievement will take, and least of all do they tell us what personality factors or what accidents of fortune will affect the fruition of exceptional ability." And, once again the importance of the Zeitgeist in determining "What talents will come to flower" is indicated.

A comparison of the most and least successful subjects in the population reflected the importance of background and personality characteristics. This study was based on two groups of subjects, 150 each, and the results indicated that "In our gifted group success is associated with stability rather than instability, with absence rather than with presence of disturbing conflicts--in short, with well-balanced temperament and with freedom from excessive frustrations."

Thus Terman's material indicates that individuals of tested high I.Q. in the early grades in elementary school continue to maintain their intellectual superiority later in life. While they may not attain the level of achievement that one would attribute to geniuses, etc., it is nevertheless apparent that for this group high intelligence is associated with significant contributions. However, high intelligence alone is not likely to lead to outstanding achievement for as Terman himself pointed out there were critical background, personality and social factors that accounted for differences between "more" and "less" successful groups in his own population.

The differences in personality and background characteristics between highly creative and highly intelligent subjects have been studied by several investigators. In these studies a psychometric definition of creativity has been used and two groups of subjects were selected. One consisted of those individuals who scored higher on psychological tests of creativity than on tests of intelligence while the other consisted of those individuals who scored higher on tests of intelligence than on tests of creativity. Rather interesting differences between the two groups appear.

Barron (1957) for his measure of intelligence used the Terman Concept Mastery Test. For his measures of originality he used the following: Guilford's Unusual Uses, Consequences B, Plot Titles B, Rorschach O+ responses, originality ratings of TAT stories, scores for infrequency of human movement responses to Rorschach-like ink-blots, scores for infrequency of correct anagram solutions, and an originality score based on a story composed by the subject. Out of 343 Air Force captains 15 were selected who were one standard deviation above the mean on the originality composite and, at the same time, one standard below the mean on the Concept Mastery Test. This was the high originality-low intelligence group. They were compared with 23 men who were one standard above the mean on the Concept Mastery Test and one standard below the mean on the Originality Composite. This was the high intelligence-low originality group. The men filled out the Gough Adjective Check List and the following appeared more frequently among the high originality-low intelligence group: "affected, aggressive, demanding, dependent, dominant, forceful, impatient, initiative, outspoken, sarcastic, strong, suggestible." For the low originality-high intelligence group the following adjectives were found more frequently--"mild, optimistic, pleasant, quiet, unselfish."

Recently Getzels and Jackson (1962) followed a similar design in their study of children in a private school in Chicago. From all students in the 6th grade through the senior year of high school these investigators selected two groups--one scored higher on intelligence than on tests of creativity and the other scored higher on tests of creativity than on intelligence. For their intelligence test data Getzels and Jackson had a variety of test scores available to them--Binet, Henman-Nelson and to some small extent, WISC scores. Comparable Binet I.Q.'s were obtained by regression equations. For measures of creativity the following were used: Word Association, Uses for Things, Hidden Shapes, Fables, and Make-up Problems. The High Creativity Group consisted of those students who were "in the top 20 per cent on the creativity measures when compared to students of the same age and sex, but below the top 20 per cent in I.Q." The high intelligence group was in the top 20 per cent in I.Q. but below the top 20 per cent in creativity measures. The results of this study were: a relatively low relationship between I.Q. and measures of creativity was obtained; despite a 23-point difference in I.Q. both high creativity and high intelligence groups were equal in scholastic performance as measured by achievement tests; and the two groups did not differ from each other on measures of need achievement. The high I.Q. group was more desirable than the average student in the eyes of their teachers, the high creativity group was not. While the two groups agreed on what makes for teacher approval, they disagreed on qualities they want for themselves. The high I.Q. students were success-oriented while the high creativity students were not. The high I.Q. students were teacher-oriented in their values (there was a fairly close relationship between qualities they wanted in themselves and the qualities they believed their teachers liked), while the high creatives were not teacher-oriented. A sense of humor was ranked higher by the creatives than the high I.Q.'s in their self-ideal rankings. On analysis of verbal fantasy material the high creatives were significantly higher than high I.Q. in stimulus-free themes, unexpected endings, humor, incongruities, and playfulness and there was also a marked tendency toward aggressiveness in their stories.

Their nonverbal imaginative productions also differentiated between the two groups. The high creatives were more stimulus-free and less bound by details, and gave more evidence of aggression. Thus it appears that the high creatives favor divergent thinking while the high intelligence group favors convergent thinking.

The high creative group was more diffuse in its occupational goals and considered more unconventional goals.

The differences between the two groups have their source, Getzels and Jackson say, not only in school experiences but also in the home environments in which they grew up. A study of their families indicated that it is the parents of the high I.Q. groups "who more frequently recall financial insecurity during their own childhood, and presumably this may still be at least a latent concern. It is the high I.Q. parents who are more 'vigilant' about their children's behavior and academic performance. They tend to be more critical of their children and of the education the school is providing. Nor is their vigilance limited only to concerns about their children's educational progress. They are vigilant too about their children's friends. The qualities they would like to see in their friends, which may be conceived of as projections of the qualities they are the most concerned with in their own children, focus on such conventional and immediately visible virtues as 'cleanliness,' 'good manners,' and 'studiousness.' In contrast, the parents of the high creativity adolescents focus on such less conventional qualities as the child's 'openness to experience,' his 'values,' and his 'interests and enthusiasm for life.'"

On an overall basis, the high I.Q. family appears to Getzels and Jackson as "one in which individual divergence is limited and risks minimized, and the overall impression of the high creativity family is that it is one in which individual divergence is permitted and risks are accepted."

Torrance (1959) presents results that are similar to those of Getzels and Jackson. In his study a difference of 25.6 I.Q. points was obtained on the Wechsler Intelligence scale for children between the highly intelligent and the highly creative group. Furthermore, "no matter what measure of I.Q. is used, we would exclude about 70 per cent of our most creative children if I.Q. alone were used in identifying giftedness." No differences in achievement were obtained on the Iowa Achievement Battery and the Gates Reading Test. High I.Q. pupils are better known by their teachers and considered more desirable by them than are highly creative pupils. High I.Q.-low creativity pupils tend to be more highly preferred by teachers than those high on both I.Q. and creativity. "Those high on both were judged by teachers as more unruly, more dominant, more ambitious, more independent, more friendly, and more studious and hardworking" than either the high creativity-low intelligence or high intelligence-low creativity groups. Pupils high on both creativity and intelligence also tended to be regarded "as most talkative, quickest to think of an idea if something goes wrong with plans, having unusual but sound ideas, and getting attention from peers for their ideas."

In terms of peer nominations pupils who are high both on creativity and intelligence receive most nominations from their peers on "talkativeness, good ideas, naughty ideas and silly ideas." The high intelligence-low creativity group tend to have most friends while the high creativity-low intelligence group tend to have fewest friends. On the House-Tree-Person Test the high creativity-low intelligence group tended to be least accessible psychologically. On the same test the high I.Q. pupils tended to draw more of the essential details while the high creatives drew more of the non-essential details. The usual standards for measuring I.Q. on this test for the high I.Q. pupils usually do not work.

Torrance also reports that in the lower grades the high creatives are more isolated and appear to be under more pressure than in the intermediate grades. Fellow pupils in the intermediate grades are better able to recognize them than in the primary grades. Torrance suggests that "Those who can maintain the isolation and withstand the pressures of this (from peers) through the later grades are probably the ones who will eventually work out."

Thus it appears that the highly intelligent person may not also be highly creative unless he is also capable of fulfilling his autonomous strivings, being open to new experiences and has the capacity and motivation to deviate from the tried and the true.

In addition to the studies just described there are several in which intelligence was the dependent variable. In these studies creative individuals were selected according to some criterion and their intelligence was studied in a variety of ways.

In 1917 Terman developed the method of "historiometry" in which various primary and secondary sources are analyzed to estimate the I.Q. level an individual might have had to perform the various activities attributed to him. This method was first applied to Galton who had often been cited as a late maturing genius. Using historiometry Terman (1917) decided that Galton was a boy prodigy and estimated that his I.Q. was not far from 200. This estimate was based on Galton's knowledge and capacities between the age of three and eight.

Cox (1926) utilized the historiometric method in a larger study. In this study Cox asked, "What degree of mental endowment characterizes individuals of genius in their childhood and youth?" To answer this question Cox started with the list of 1,000 eminent men assembled by Cattell, and eliminated those who were of the hereditary aristocracy and nobility, eminent men born before 1450, and of those remaining, the men beyond the rank of 510 on the original list were also dropped. The remaining subjects were 282 eminent persons who lived between 1450 and 1850.

In addition to this group of 282 she included a group of 19 subjects whom she had used for preliminary study and who had appeared beyond the 510th name on the list. The professions in the final group included: writers, statesmen and politicians, scientists, soldiers, religious leaders, philosophers, musicians, and revolutionary statesmen.

Cox made two I.Q. estimates for each of her subjects, one at the age of 17 (AI) and the other at the age of 26. The average I.Q. of her group was 155.

She also compared the men ranked highest with those ranked lowest in her group and found that the first 10 and highest I.Q.'s were "significantly above the average of a group of typical geniuses." She also emphasizes a point which is quite germane in evaluating the data on intelligence that the lowest I.Q.'s "compensate for these low ratings by their relatively greater *balance* and *activity*;" and "*that high, but not the highest intelligence combined with the greatest degree of persistence, will achieve greater eminence than the highest degree of intelligence with less persistence.*"

The basic finding that intelligence alone is insufficient is supported by Anne Roe's (1952) studies. Roe investigated the intelligence of her subjects using a specially designed Verbal-Spatial-Mathematical Test and obtained a rather large range of scores. Where comparable data were available, she found that some of her subjects did not score as high as the average Ph.D. She concludes by saying that, "It seems quite clear that, having chosen your general field, the particular kind of work you do in it is related in some degree to your particular capacities. How well you do in the field is partly a function of your capacity for that particular field, but even more a function of how hard you work at it." It should also be noted that Roe (1952) also found her groups to differ from each other on the three intellectual capacities studied. She reports that the social scientists and theoretical physicists were higher in verbal than non-verbal abilities; experimental physicists were the reverse of this; and anthropologists were relatively low in mathematical ability. That there were exceptions to the generalizations suggests that these abilities were a factor in vocational choice, but not a decisive one.

In addition to persistence another important ingredient is opportunity for creativity. Meer and Stein (1955) studied 64 research chemists employed in two major departments of a large industrial organization. The men were ranked with respect to creativity by their department heads and intelligence was studied with the Miller Analogies Test and the Wechsler-Bellevue Intelligence Scale. For all subjects combined the results indicated a significant relationship between creativity and intelligence. When education was held constant, however, the positive relationship between creativity and intelligence was obtained only for the non-Ph.D.'s in the population. Intelligence and creativity rank were not related in the Ph.D. group. The discriminating tests for the non-Ph.D.'s were the total score on the MAT and the vocabulary and information subtests of the Wechsler-Bellevue.

Meer and Stein believed that researchers with Ph.D.'s may not be evaluated for intelligence when recruited and the later opportunity they get for creative research is more related to the fact that they possess the Ph.D. Therefore, for them, measures of intelligence are not related to creativity. Men who do not have the Ph.D. are, relatively speaking, low status individuals in an organization that also contains Ph.D.'s. For them, high verbal intelligence, as manifest in tests of vocabulary and information, would raise their status and help them obtain the opportunity to do creative research.

To check on the overall hypothesis that intelligence may be related to the opportunity for creativity, all research sections in each of the two departments were rated by the department heads for importance of the section's activities to the company. It was assumed that men in the more important sections would encounter fewer obstacles (e.g., lack of funds or equipment) to do creative work. The results indicated that in the high opportunity groups, neither the MAT nor the full scale Wechsler differentiated the creativity status of the non-Ph.D.'s.

Meer and Stein conclude their study by suggesting that when opportunity is held constant "I.Q.-ness" beyond a certain point (about the 95th percentile) becomes less significant for creative work. They conclude with the observation that the findings in this investigation also point to the importance of understanding environmental factors in relation to creativity.

Additional information is available on the relationships between the social organization, creativity, and intelligence in an unpublished report by Stein based on Ph.D. research chemists in four industrial research organizations. The creativity of the 96 men was evaluated by ratings obtained from their superiors, colleagues, and subordinates, and two groups--one of "more" and one of "less" creative individuals--were established and the intelligence of each man was tested with the Miller Analogies Test (MAT). The overall results indicated that while the more creative men scored somewhat higher on the MAT the difference between the more and less creative men was not statistically significant.

A breakdown of the data by company revealed rather interesting insights. In one of the companies studied there was no significant difference between the I.Q. scores of the more and less creative men. Furthermore, their level of I.Q. was generally higher than that of the other groups studied. In the second company a significant difference between the more and less creative groups in intelligence was found and their combined average I.Q. was lower than that obtained for two other groups.

When the data for these two companies were presented to their respective managements they said they saw in the data some suggestions as to their administrative problems. In the company where the more and less creative men were similar in I.Q. management said that one of their problems was that they had too many "Chiefs" and no "Indians." In this company when they recruited personnel,management did not differentiate between the problems they wanted work on. They always sought the very best man regardless of the importance of the problem or how much money they intended investing in pursuing answers to the problem.

Management in the second company said that when they recruited people they did differentiate between the types of problems they had. If they decided they were going ahead on a particular problem area,they sought the man for that problem. If they were going to invest a great deal they wanted the best man they could find. If they were not going to invest very much then they hired "most anyone" capable of doing the job. The differences in intelligence seemed, at least in part, to be affected by their differences in recruitment policy.

As a check on the second company's statements, the states from which the men came were spotted on a map of the United States. And, indeed, the more creative men came from a variety of states all over the map, while the less creative men had come from locations within a radius of 50 or 100 miles around the company.

In contrast to the studies cited above there are other studies in which some measure of intelligence has been found to be correlated with a measure of creativity.

Drevdahl (1956) studied graduate and advanced undergraduate students in the sciences and the arts for whom the creativity criterion was faculty ratings on a 6-point scale. The group was split at the 50th percentile and both halves compared on the techniques used. One of them was the Thurstone Primary Mental Abilities Test on which the creative group scored higher on verbal meaning. No other significant differences were obtained and there was no significant relationship between creativity and general intelligence.

Barron (1957) studying Air Force officers found a correlation of .33 (significant at the .01 level) between the Concept Mastery Test and an Originality Composite score based on Guilford's Unusual Uses, Consequences B, Plot Titles B, Rorschach O+ responses, originality of TAT stories, scores for infrequency of human movement to Rorschach-like ink-blots, scores for infrequency of correct anagram solutions, and an originality score based on story composed by subject.

MacKinnon (1959a) also reports a relationship between intelligence and creativity. He studied a group of 45 industrial researchers who were doing work in the field of guided missiles and electronics. These subjects were rated on a series of 17 variables by supervisors and peers. A factor analysis of the ratings revealed six factors and one of them, "General Competence," accounted for most of the variance. Other data obtained at IPAR were related to this variable and differences between more and less competent individuals studied. The results of this analysis indicated that the more competent researcher scored higher on standardized tests of mental functioning (test not indicated) and in the other assessment procedures revealed himself as possessing a high degree of intellectual efficiency and intellectual capacity.

Nevertheless, in another study MacKinnon (1960) points out that "It is not surprising that no feebleminded subjects turned up in any of our samples (of creative workers in the arts, sciences, and professions), but it is worthy of note that in our various groups intelligence (as measured by the Terman Concept Mastery Test) is not significantly correlated with creativity. Among creative architects the correlation of the two variables is -.08, a value not significantly different from zero."

The second study reported by MacKinnon is consistent with results found in other studies in which manifestly creative individuals were studied. In his study of industrial researchers where a relationship between creativity and intelligence was fou... there is no indication that such factors as equal opportunity (Meer and Stein, 1955) were controlled for. The two remaining studies in which a relationship between creativity and intelligence were reported were both based on subjects whose creativity was manifest in "academic" situations and in one (Barron, 1957), although the correlation was significant, it was low (.33).

Summarizing the research in which studies were made on intelligence levels of individuals who were regarded according to one criterion or another as creative, we may say that the evidence indicates that while I.Q. and intelligence may be related in the general population among creative persons there is a range of I.Q.'s and their average I.Q. is high. But "I.Q.-ness" alone is insufficient. In addition to I.Q. the individual requires certain personality characteristics some of which have already been mentioned and others which will be discussed in the next chapter, as well as the opportunity to manifest one's creativity. Furthermore, individuals may make up for what they lack in I.Q. through the utilization of other psychological characteristics.

Imagery

In discussing their experiences during the creative process individuals have at times described the images that occurred to them. Agnew (1922) reports on the experiences of Schumann, Mozart, Berlioz, Tschaikowsky, and Wagner and points out the spontaneity of their imagery which was primarily auditory. He also found evidence which indicated they also possessed visual and kinaesthetic imagery and that auditory memory was also important.

Cowell (1926) the composer, also supplies evidence for the importance of auditory imagery in music. He says, "the most perfect instrument in the world is the composer's mind. Every conceivable tone quality and beauty of nuance, every harmony and disharmony, or any number of simultaneous melodies can be heard at will by the trained composer." Cowell distinguishes between the composer who is capable of such imagery and the performer who is capable of it to a lesser degree.

In the area of mathematics we find the work of Hadamard (1945) who describes how he built a vague schema which provided unity to his work. Introspectively he does not believe that words were present but visual images were and from what he knows of other mathematicians Hadamard believes that their images were frequently visual but also kinetic and auditory.

In contrast to the anecdotal material presented above there is the systematic work of Anne Roe (1951b). Roe interviewed 61 of her subjects and inquired as to the forms in which thoughts were handled by them. She found that biologists and experimental physicists were primarily visual while theoretical physicists used mainly verbal or other symbolic images. Psychologists and anthropologists used mainly verbal imagery. The relationship between vocation and imagery was significant and although the evidence is not clear on this point Roe believes that the type of imagery influences vocational choice rather than that the field of work develops a particular type of imagery in the person. Roe also suggests that men who did not follow the imagery pattern of their group tended to be different from their colleagues in other ways, e.g., early interests. Finally, Roe points out that the imagery of her subjects was related to the verbal or non-verbal nature of their father's occupations.

Perception

The perceptual literature in the area of creativity may be divided into two major groups. One concerns itself with the subjects' perceptual processes and the other with his preferences for various forms.

Brighouse (1939a) interested in "apperception" which included both perception and evaluation presented 10 paintings representing a wide variety of s[illegible]tter tachistoscopically to three groups of subjects totalling 94. T[illegible]he subjects were children from 8 to 14. Thirty-four were "art[illegible]ned" adults who were either graduate students in the Departme[illegible] and Plastic Arts at the University of Iowa and 38 who were artistically untrained who had no instruction in art. The subjects were seated before the tachistoscope and the paintings exposed for one-quarter of a second. The exposures were repeated until the subject felt that nothing new had occurred to him. Finally, the picture was left on the screen as long as the subject wished and he was asked whether he liked it and whether he found any differences with what he had seen during the short exposures.

Brighouse distinguished three stages of apperception: a "mass" report or survey, concentration on details, and an integrative stage. The latter stage was reached by all the trained but only by three of the untrained adults. No evidence for "perceptual types" was found.

Stein and Meer (1954) also used tachistoscopic presentation of visual stimuli. Their stimuli, however, were not paintings but Rorschach cards. This study was based on two major assumptions: (a) a good Gestalt is a function of the perceiver and the characteristics of the stimulus field; (b) to structure an ambiguous stimulus draws more heavily on the individual's resources than does a more structured stimulus. It was therefore hypothesized that more creative subjects having greater personal resources would develop more hypotheses and better Gestalten under varying conditions of ambiguity than would less creative subjects.

To test this hypothesis 18 industrial research chemists, each of whose creativity was rated by their superiors and colleagues, were presented with the 10 standard Rorschach cards. The cards were exposed at four different exposure levels--.01 of a second, .10 of a second, 3.00 seconds, and full exposure.

Only the first response to each Rorschach card was scored. The scoring system was an 8-point form-level rating scale having the following categories: (a) autistic, (b) rejection, (c) card description, (d) sensory, (e) sensory-form, (f) fair-form, (g) form dependent on the demand characteristics of the stimuli and (h) well-integrated form.

The reliability of the scale had been previously established and previous research was used to develop a weighting system. The weighting system took into account the form-level rating of a response and the frequency of that rating to a specific card at each exposure level. Consequently, well-integrated responses to the most difficult cards at the shortest exposure levels received the highest scores.

A total weighted score was calculated for each subject and a biserial correlation of +.88 between this score and the subjects' creativity status was obtained. The high and low creativity groups were significantly different from one another at each exposure level. The "highs" rejected fewer cards, gave more autistic responses at the lowest exposure level, and gave responses that were more "fair-form" or better, at that level as well. They also gave more "well-integrated form" responses. On the other hand, when the number of rejects was held constant, the two groups did not differ with respect to the "well-integrated" response category.

Intelligence as measured by the Wechsler-Bellevue was significantly correlated with creativity ratings and Rorschach scores. When intelligence was partialled out, it was found that intelligence accounted for only a small portion of the relationship between the Rorschach and creativity. And therefore, the authors suggest that factors other than intelligence may account for the relationship between the Rorschach scores and creativity. Specifically the authors believe that the results suggest, "the real difference between our high and low creative individuals may turn out to be a function of defensiveness or over-criticalness which inhibits the generalization and communication of hypotheses."

In the second major category of perceptual investigations are those which have concentrated on the preference for different forms. Brighouse (1939b) assumed that "individuals differ in their ability to synthesize varieties into unities and that they appreciate as most beautiful that particular level of complexity which requires some effort to 'fuse.'" C. O. Weber had previously applied this hypothesis to the graphic arts in which he found a relationship between "complexity preference" level and "apperceptive power." To further test the relationship between experience and preference for complexity, Brighouse employed geometric figures developed by G. D. Birkhoff. These figures varied in "order" and complexity. Birkhoff expressed this in a mathematical relationship which produced a definite measure of unity and variety. M (esthetic measure) = Order/Complexity.

Brighouse reproduced 48 of Birkhoff's figures, four each on cardboard size 13 x 15 inches. Each group of four had a constant M value, but varying complexity values. Three hundred fifty-two observers (trained and untrained children and adults and 50 feebleminded) recorded their preferences, ranking the figures on each cardboard from one to four. The results contradicted Weber's hypothesis and experiments. Increasing age and experience in art produced increasing preference for simpler forms. Further, when the test was given a second time to 64 of the adults, there was no evidence of a shift in preference toward the more complicated forms.

Brighouse concludes that artistically trained observers looked for unity and simplicity of organization while the untrained preferred the "interestingness" of varied, involved, and complicated forms. Possibly Weber's hypothesis was not confirmed because it may apply to other aspects of painting but not to simple forms.

Barron and Welsh (1952) were more successful in differentiating artists from non-artists with forms that varied in simplicity and complexity. The authors administered free-hand figures to 37 artists and art students and to 75 male and 75 female non-artists. The non-artists were quite heterogeneous with respect to age, education, occupation, and geographical location. Item analysis revealed that the artists disliked ($p = <.01$) 40 items (all of the simple-symmetrical sort) and liked 25 items ($p = <.05$) (largely of the complex-asymmetrical sort) more often than did the non-artists. In this fashion, a 65-item scale was established wherein agreement with artistic preferences earns a high score. In the original study, the group mean differences were highly significant, although the distributions overlapped somewhat. A cross-validation study of 30 artists and 30 non-artists yielded similar results. A new sample of 80 non-artists established the odd-even reliability of the test at .96.

The correlates of complexity have been studied at the Institute of Personality Assessment and Research at the University of California and the following consistent, although moderate (r's range from .20 to .50) relationships are reported by Barron (1953).

1. Complexity was found to be related positively to the Institute of Personality Assessment and Research staff ratings of personal tempo, verbal fluency, effeminacy, sentience, and sensuality. It was related negatively to constriction, good judgment, rigidity, conformity, and submissiveness. A high positive correlation with ratings of deceitfulness, and negative correlations with ratings of naturalness, likeability, adjustment, and abundance values, did not hold up under cross-validation.

2. The preference for complexity was also related positively to faculty ratings of originality, good basic taste as measured by a design test, art faculty ratings of Turney designs performance (mosaics), independence of judgment in the Asch "lines" experiment, and the F, Mf, schizophrenia, psychopathic deviate, and anxiety (Welsh) scales of the MMPI. It correlated negatively with the MMPI hysteria scale, the political-economic conservatism scale, the Levinson-Sanford Ethnocentrism scale, and self-rated conformity.

3. A revised form of the complexity scale showed positive correlations in two other samples with staff ratings of intellect, sense of humor, breadth of interest, and cathexis of intellectual activity.

In another report Barron (1958) states that both painters and doctoral candidates in the physical sciences preferred the complex asymmetrical drawings and these results were supported by trends found in free expression tests.

Rosen (1955) used the Barron-Welsh Figure Preference Art Scale to investigate whether it would relate to the merit of the art work produced and to the degree of advancement the artist reached.

The scale was administered to 22 beginning and 22 advanced students, eight art faculty members and a group of non-artists who were faculty members of other departments. It was found that the scale did not differentiate between the art students, nor were the art students' scores distinguishable from those of the art faculty. However, both students and art faculty did score higher than the non-artists. Thus while the scale scores did not increase as a function of training it did differentiate between artists and non-artists.

In the second part of this study one art product of each student was rated on a 5-point scale of originality by each of the faculty. The correlation between art-scale score and the average of faculty rated was .40 ($p = .02$) and the correlation between art-scale score and grade-point average was .35 ($p = .05$). These correlations are within the range reported by Barron (1953).

Barron (1958) interprets his results as reflecting the creative person's tendency to cope with complexity and to derive satisfaction from their synthesizing abilities. They reflect the creative individual's striving to integrate diverse phenomena into "an elegant new order more satisfying than any that could be evoked by a simpler configuration." Barron (1953) also suggests that the preference for complexity is associated with (a) the psychoanalytic concept of orality and its derivatives, i.e., originality, artistic creativeness, the acceptance of femininity in men, etc., and (b) impulse acceptance and the absence of repression, i.e., sensuality and the patterning of MMPI scores (socially dissident and uninhibited attitudes).

Stein with the aid of Stern and Lane developed a perceptual test (Physiognomic Cue Test) based on developmental aspects of perception. Developmentally perception is said to move from being more physiognomic in character to a state in which the formal characteristics of the stimulus are focussed on. Since it was assumed that creative individuals might be able to utilize more repressive features of perception or because their perceptual processes are more flexible, it was hypothesized that their perceptions should be more physiognomic than form-dominated.

The physiognomic Cue Test consists of 24 drawings or figures, each of which might be perceived in two alternative ways. For example, the subject is presented with two arcs, one above the other and spaces between them at either end, and he is asked whether he sees them as "two arcs" or an "open mouth." Each of the alternatives represents the ends of a 7-point continuum. Since the first alternative, "two arcs," attends to the literal aspects of the stimulus it is called a "form percept." The second, because it attributes animate characteristics to the stimulus is called a "physiognomic percept." There are two sets of physiognomic percepts--feeling-physiognomic and thing-physiognomic.

Walker (1955) used the Physiognomic Cue Test with six mathematicians and 12 chemists who were rated high on creativity by their university colleagues and compared them with five mathematicians and eight chemists at a smaller university. The latter were not rated on creativity. Walker assumes they were less creative because they were at the smaller institution. Using several of Thurstone's tests Walker did not find any significant differences between his two groups. However, differences were obtained with the Physiognomic Cue Test. The control group scored higher on form perception while the creative group scored higher on physiognomic perception. In his study of "more" and "less" creative Ph.D. chemists employed in industrial research organizations, Stein (unpublished) found trends that were in the same direction as those reported by Walker. Only when the chemists were equated for area of work were significant differences found and then only for "thing-physiognomic" scores.

Summarizing the perceptual studies that have been reviewed, we find process studies indicate that creative individuals are more capable of integrated percepts and more free in suggesting hypotheses for poorly structured stimuli than are their less creative counterparts. Those studies concerned with the preference for visual forms have indicated that the more creative subjects show more preference for physiognomic percepts and complex forms. Where these perceptual data have been related to personality factors it has been suggested that the more creative individuals are less defensive and less self-critical and take greater satisfaction in making order out of complexity than their less creative colleagues.

Thinking and Problem-Solving

Investigators in the area of creativity have also shown a great deal of interest in their subjects' thought processes and problem-solving capacities. A variety of procedures and theoretical orientations have been used. They include factor-analytic studies, experimental situations and attempts to develop specially designed tests. In terms of theory they include associationism, Gestalt theory, and psychoanalytic theory. Because theory and procedure overlap in some instances and not others there are problems in classification. The classification system used here is not unidimensional but rather based on some outstanding characteristic of the research which should identify it. A separate sub-section is devoted to "tests" which were specially designed for studying or selecting creative individuals. However, instruments and procedures described in the other sub-sections might also be used for similar purposes.

Guilford's Factor-Analytic Studies

For Guilford, creativity is not a unitary phenomenon but a "collection of different component abilities or other traits" (Guilford, 1957). Different forms of creativity may involve different patterns of abilities and none of these abilities is unique to the creative individual. The abilities may be found in different grades in all people and hence may be studied in people who are not necessarily distinguished for their creativity. With knowledge of these factors and with tests to measure these factors, it is then possible to select individuals for their creative potential and to develop constructive educational programs.

Guilford's work on creativity, carried out at the Psychological Laboratory at the University of Southern California, is part of a more general investigation of intellectual factors and over a period of years has undergone elaboration and refinement. In one of the latest reports (Guilford, 1959a)53 factors have been identified which are grouped in three dimensions. One dimension "represents the varieties of activities or _operations_ performed--_cognition_, _memory_, _divergent thinking_, _convergent thinking_, and _evaluation_." These range from the discovery of information (cognition) to the testing of information (evaluation).

The second dimension "represents variations in kinds of material or _content_ to which the operations may be applied" and the four varieties of contents are _figural_, _symbolic_, _semantic_, and _behavioral_.

The third dimension is that of _products_ of which there are six--_units_, _classes_, _relations_, _systems_, _transformations_, and _implications_.

There is still the possibility of a fourth dimension, that of variation in sense modality.

Using this unified theory of the intellect, Guilford (1959a) suggests that "creative abilities are to be found in the general category of divergent thinking, with the exceptions of the factors of redefinition, which are in the convergent-thinking category and the factor of sensitivity to problems, which is in the evaluative category." In addition transformation which includes such factors as visualization, redefinition and judgment "should be given special consideration."

Tests have been developed during the course of Guilford's research program which are designed to measure the specific factors. These have been investigated in a variety of studies by members of Guilford's own group as well as others. Before turning to these studies it is well to state some of the personality correlates of several of the factors.

It has been found (Guilford, 1959b) that "...individuals who are high on scores for *ideational fluency* are inclined to be more impulsive, more ascendant, and more confident, and to have a stronger appreciation of creativity. Individuals who show more than ordinary signs of nervousness and depression are likely to be slightly lower on tasks requiring *ideational fluency*, but they show no handicaps on other types of fluency tests....Those who score higher in tests of *expressional fluency* are inclined to be more impulsive, to appreciate aesthetic expression and to like reflective thinking....The original person tends to be more confident and tolerant of ambiguity and to like reflective and divergent thinking and aesthetic expression. The unoriginal person is inclined to be more meticulous and to feel a need for discipline....The hypothesis that *originality* rests upon an attitude of unconventionality is not supported."

Over a period of years the tests developed by Guilford have been utilized in a variety of studies and they cast light on the creative process and the validity of the tests.

In 1956 Guilford reported a series of studies on factor validities using course grades as criteria and the results of these investigations revealed that: (1) Greatest validity was found for verbal comprehension and general reasoning in lower-division science and mathematics courses. Numerical facility played its greatest role in mathematics but spatial orientation played little role. Only a small relationship was found between visualization and grades in biological science. (2) Visualization correlated "more than .20" with grades in engineering drawing, descriptive geometry, celestial navigation and physics. With grades in algebra and trigonometry the reasoning-composite factor correlated substantially and adaptive flexibility somewhat. (3) The general reasoning factor correlated significantly with all three mathematics courses and all three scientific courses at the Coast Guard Academy. In this same study verbal comprehension did not show up too well, eduction of patterns yielded no significant correlations but logical evaluation had three. (4) In another study at the Coast Guard Academy, a composite of factor score tests yielded better prediction in four out of five courses (science and mathematics) than did a mathematics achievement test. Combining the factor tests with the mathematics test improved prediction. (5) Guilford reports a study by Hills that attempted to predict mathematics achievement of 23 groups of students in three institutions of higher learning in Los Angeles. Tests for the following nine factors were administered: verbal comprehension, general reasoning, numerical facility, spatial orientation, visualization, adaptive flexibility, logical evaluation, eduction of patterns and originality. The students majored in mathematics, physics and engineering. The criteria were course grades, examination scores and faculty ratings. The results indicated that: verbal comprehension and general reasoning do well at the lower levels but not at the higher levels. Spatial orientation was significantly related to success in mathematics for engineering and mathematics students, but not for physics students. In some instances visualization was related to achievement in mathematics. Adaptive flexibility had the highest median correlation; logical evaluation had a preponderance of positive correlations; eduction of patterns had zero validity; the median correlation for originality was zero. (6) Using pay-rate increments as criterion for engineers the following achieved significance: symbol manipulation, eduction of patterns, spatial visualization, ideational fluency, eduction of correlates and adaptive flexibility. (7) With operations analysts general reasoning, spatial visualization, a complex of factors for which Number Series was the test and logical evaluation were significant.

Chorness (1956) reports a study concerned with the prediction of creative expression among 50 students. The students were involved in a lecture-discussion and rated on "audience interest and reaction, degree of spontaneity, ability to transcend rote material, originality of expressions, etc." These ratings yielded four factors, three of which were identified as audience reactivity, native ideation and problem sensitivity. Ratings on originality and spontaneity did not load significantly on any dimension but they were retained to see how they related to other test data.

After removing the effects of intelligence and studying the multiple correlations between the factor composites of the Guilford battery and criterion scores, Chorness says, "it would appear that the creativity tests can carry the burden of prediction," and that a test of controlled associations was the best predictor. The factor composite also predicted the students' grades better than did an intelligence test.

Saunders (1956) studied 800 engineers in five companies with a battery of 56 measures that included both intellective and non-intellective measures. The criterion was supervisors' ratings on an 8-point scale in response to the following questions: "Is he the kind of person that you'd like another person to be like? Is he generally successful compared to his job requirements?" These ratings were regarded as measures of success. Among the tests included in the battery were three creativity tests: Consequences Test, Controlled Association Test, and Idea Classification Test. The scores on these tests were based on the distinction between obvious and remote responses, frequent and uncommon responses, and banal and clever responses. Relatively poor success was obtained with the measures used. On the Controlled Associations Test, it was found that the frequency of obvious, common responses was the best single predictor of success. The more successful men had the highest frequencies. Saunders suggests that this test may measure effectiveness of communication and it may not be the predictor one would want to use. Those engineers engaged in research or basic development did give more remote solutions on the Idea Classification Test than did those involved in product development but remote responses did not differentiate success within function. However, the successful men in the research group did give a greater number of obvious solutions than did the unsuccessful men. The Consequence Test failed to differentiate either function or success. Various reasoning tests were also employed by Saunders and one of them, a measure of inductive reasoning that employed sets of numbers, was found to be superior both to a test involving verbal analogies and a more conventional problem-solving test. This test differentiated between engineers engaged in research or basic development and those engaged in product development work. It also predicted success within jobs as well.

Drevdahl (1956) in his study of graduate and advanced undergraduate students found no significant differences on the following Guilford factors: redefinition, closure, ideational fluency, spontaneous flexibility, associational fluency, or sensitivity to problems. Word fluency and adaptive flexibility did not differentiate at the .05 level but a low (significant) relationship between the criterion and high scores on these factors was found. Originality did not differentiate between the two groups.

MacKinnon (1959a)in his study of more and less competent industrial researchers found that the more competent ones do not score higher on two of Guilford's tests, Unusual Uses and Consequences--measures of educational fluency. But as the assessment staff saw them they gave the impression of greater intellectual flexibility and as possessing a greater wealth of ideas and hypotheses and a richer educational responsiveness.

On several measures of unusualness of mental association (tests not indicated), the more competent scored higher but the differences between their scores and those of the less competent researchers were not significant. MacKinnon suggests that,"The consistency with which the differences appear, however, suggests that with more adequate measures it might be possible to demonstrate a greater unusualness of mental associations as characteristic of the more competent researchers."

Association Theory

It is apparent that a number of Guilford's tests are based on association theory. But the use of association theory is most central to the work of Mednick (1962). He defines "the creative thinking process as the forming of association elements into new combinations which either meet specified requirements or are in some way useful. The more mutually remote elements of the new combination, the more creative the process or solution." This theory is intended to apply to all fields of creative endeavor, although as work continues it may undergo modification (e.g., it may apply to some fields better than to others). In terms of this theory there are three ways of achieving a creative solution; serendipity, similarity, and mediation.

Using the aforementioned definition Mednick (1962) reports a test of creativity called the Remote Associates Test (RAT) in which the subject "is asked to form associative elements into new combinations by providing mediating connective links...the combination must meet specified criteria that are experimenter composed." The test consists of "sets of three words drawn from mutually remote associative clusters" and the subject is to respond with a word that serves as an associative link between the three. An example, given by Mednick, may make this clearer.

The subject is presented with three words, "rat," "blue," and "cheese." The correct associative link is "cheese" because it is present in word pairs"'rat-cheese'", "'blue-cheese'", and "'cottage cheese.'" Two college level forms of the test exist. Both have 30 items each and the subject is allowed 40 minutes to complete it. His score is the number right.

The reliability of the test is quite high, .92 in one study and .91 in another. A series of validation studies are presented by Mednick (1962) the results of which are as follows: In one study students in a college of architecture whose creativity was rated by their instructors in design classes it was found that RAT scores correlated .70 ($p = <.01$) with the criterion. In a second study RAT scores served as the independent variable for separating first year psychology graduate students at the University of Michigan to "high RAT" and "low RAT" scorers. The two groups were rated on research creativity by their instructors. And the results were that "of the eight high RAT scorers, six were rated high on research creativity and two were rated low; of the seven low RAT scorers, only one was rated high, the other six being rated low." Using high and low MAT scorers against the same criterion, no such marked results were obtained. The RAT test has also been found to correlate negatively (-.27, $p = <.05$) with the first-two-year grade point average of undergraduates in a school of technology and summer school students in an Eastern liberal arts college (the correlation was not significant in this instance). Miller (1960) found that high RAT scorers tended to receive higher grades from teachers rated as flexible than from teachers rated as dogmatic.

Kowalski (1960) compared high RAT and low RAT scorers on interests and attitudes. The high scorers were found to be more "atypical and 'liberal'" in attitudes and on the Strong Vocational Interest Blank they were found to score higher on artist, psychologist, physician, mathematician and author-journalist scales. The low RAT scorers scored higher on the farmer, math-physical science high school teacher, office man and pharmacist scales. Furthermore, the significance of the high RAT scorers had less overlap with the general population than did the low RAT scorers.

The RAT has also been related to other measures of associative behavior and it has been found that the RAT correlated .38 ($p = <.01$) with number of associations (Craig and Manis, 1960), and to the originality and quality of anagrams using "Generation" as the test word (Karp, 1960; Kowalski, 1960). In another investigation (Houston and Mednick, in press) a need for novelty is posited for high RAT scorers.

Finally, Mednick (1962) reports that the RAT was given as part of an assessment battery at IPAR to a group of 40 highly eminent architects, and it was found to correlate .31 with the originality scale of the IPAR Questionnaire Scale and -.31 with the total Conformity Score in the

Crutchfield Conformity Experiment (Crutchfield, 1955). In interview ratings the high scorers were rated significantly higher on "'graceful and well-coordinated in movement'" and "'reticent and taciturn in speech.'" The subjects reported that college grade point averages correlated -.34 with RAT scores.

Psychoanalytic Theory

According to psychoanalytic theory one of the important differentiations to be made in thought processes is that between primary process and secondary process. Primary process thinking is dominated by drives while secondary process thinking is controlled. Theoretically the creative individual is capable of both processes while the individual who is lacking in creativity or who is "less" creative may be either drive dominated or excessively controlled. A more elaborate statement of the theoretical basis for the studies that follow may be found in Rapaport (1951) and Kris (1952).

In one study conducted by Pine (1959) the author was concerned with the products of creative activity and in the second by Pine and Holt (1960) the authors were concerned with creativity from the standpoint of the person. In the first study Pine studied essentially uncreative subjects in a literary task (stories told to the TAT) and in a task of scientific hypothesis formation and found that the quality of the productions varied with the amount and control of drive content in the product.

The second study involved three major hypotheses which, combined, "state that the quality of a person's created productions is unrelated to his tendency to express more or less primary process material on the Rorschach but is related to his tendency towards more or less effective control over expressed primary process content and to a combined score (adaptive vs. maladaptive regression) taking both amount of expression and effectiveness of control into account. Thus, it was expected that the quality scores on the various experimental tests would be correlated with the control and with the combined scores but not with the score for amount of expression alone."

To obtain measures of the quality of imaginative productions the following tests were used: TAT, Science Test, Humor Test, Rorschach, Animal Drawing, and Guilford's Brick Uses and Consequences Tests. To assess expression and control of primary process in the Rorschach test Holt's manual was used (Holt, 1959; Holt and Havel, 1960). Thirteen male and 14 female undergraduate students served as subjects.

The amount of expression of primary process and effectiveness of control over such expression were found to be statistically independent. For males, the results on all tests, and the over-all scores for both males and females supported the hypothesis that quality scores on the tests of imagination would be unrelated to the amount of primary process expression and positively related to the effectiveness with which this expression is controlled.

Barron (1957) also pointed to the importance of primary and secondary process thinking in his study of two groups that varied in originality and intelligence scores. He suggested that "Primary process thinking to the exclusion of the secondary process marks the original but unintelligent person, secondary process thinking which carries the ego-control to the point where the ego is not so much strong as muscle-bound marks the intelligent but unoriginal person, and easy accessibility of both primary process and secondary process marks the person who is both original and intelligent."

Process Characteristics and Gestalt Theory

In contrast to the types of investigations described above, there are others which involved the investigation of the process or the on-going course of events as the creative individual copes with the problem that confronts him.

Wallas (1926) was one of the first to differentiate a series of four stages in the creative process. These were: preparation, incubation, illumination and verification. In the preparation stage the problem is investigated from all directions; incubation is that period in which the individual is not consciously thinking about the problem; illumination is the stage during which the "happy idea" occurs; and verification refers to that stage in which the validity of the idea is tested and the ideas reduced to exact form.

Catharine Patrick (1935, 1937, 1938, 1941) studied the relevance of Wallas' analysis in a series of studies in art, poetry and science. Her results substantiate Wallas' ideas. Her study of poets will illustrate her approach and results. In this investigation her subjects were 113 persons divided as follows: 55 were poets whose work had been published in well-rated magazines, the remaining 58 represented a variety of professional groups, students and housewives who had never written poetry except possibly as a school assignment. The subjects were equated for age, sex, race, and intelligence as estimated by a vocabulary test.

To gather data on the creative process a picture was presented to the subject with the instruction to write a poem about it or anything that occurred to him while looking at the picture. The subject was asked to talk aloud so that a running protocol could be obtained. When the poem was completed a questionnaire pertaining to the poet's characteristic method of writing was administered orally to the poets.

The protocols were divided into four parts on the basis of total time consumed. The results obtained were: 50 per cent of the thought changes (as measured by new sentences) occurred for both groups during the first quarter and is cited as evidence for Preparation--the period during which one would expect associations to shift and for the subject to receive ideas. The Incubation period was defined as that period during which there was spontaneous recurrence of a mood or idea, somewhat modified, while the subject was talking of other things. Evidence for this was said to be found in the fact that two-thirds of the poets and four-fifths of the controls gave evidence of an idea early in their report which occurred later one or more times and finally appeared as the chief topic of the poem. With regard to illumination it was found that two-thirds of the lines were formulated for the first time in the second and third quarters. Finally verification included revision of lines, two-thirds of which occurred in the last category.

The stages overlapped and did not follow in precise order--thus preparation was not all over before incubation began and so on. Comparing the poets'behavior during the experiment with what they described as their behavior when they worked on their published poetry, it was found that their behavior in the experiment was generally characteristic of their work. Poets and control subjects gave evidence of the same four stages, the same number of subjective and objective poems, the same proportion of time spent in preparation, and approximately the same total time and length of poems. Poets tended to look for deeper meanings, employed more literary devices and tended more toward personification. The poets also gave more evidence of current conventions in writing poetry.

Although subjects and approaches differed in Patrick's other studies basically the results were the same--they were regarded as supporting Wallas' stages.

Eindhoven and Vinacke (1952) were critical of the type of research described above on the following grounds: they were based on introspective reports from a few people, and may not have been representative of creative individuals in general, the data have been obtained in highly controlled laboratory studies rather than in natural creative situations, and the results were analyzed in terms of a priori considerations. Their effort was therefore devoted to a two-fold purpose: a) to obtain examples of artistic creation under conditions that were as spontaneous as possible and (b) to analyze the products and behavior of artists in ways conforming to the actual requirements of the task rather than to an a priori scheme.

Their subjects were 13 professional artists and 14 non-artists. The former were 41 years of age on the average and their average IQ measured by the Otis Higher Examination was 116.9. The non-artists averaged 33 years of age and their average IQ was 118.

The subjects were asked to produce a monochromatic picture for a poem. They made one visit to the laboratory where materials were supplied and they were observed by one of the investigators. Laboratory visits were unscheduled, the subjects came whenever they wished and stayed as long as they wished. A maximum of four visits was set and it was suggested that subjects limit any one session to an hour.

Analysis of the data covered three aspects of the problem (1) the distribution of time over various activities and over the process,

(2) characteristics of the products (e.g., size, number, placement, materials, etc.) and (3) process characteristics.

Both similarities and differences were found for the artists and non-artists. Among the similarities were: The production evolved over a considerable period of time. As the sessions progressed the proportion of time spent in actually sketching and in working on one particular sketch increased. Typically more than one sketch was produced and while the motif was established fairly early, subject matter, composition, etc. changed many times. In painting a picture the steps usually involved delimitation of space and arrangement with details coming later. Preliminary work was usually done in pencil with more permanent media used later in the work.

Among the differences found were: During the early stages the artists spent more time and produced more new sketches and they also spent more time on the final sketch than did non-artists. The latter tended to produce about the same number of new sketches and take the same amount of time at all stages. Artists started with small, off-center pencil sketches which they executed rapidly. Later they shifted to larger centered sketches which they executed more slowly and with more than one medium. Non-artists tended not to vary their work and their works were usually large, centered, brush sketches. Artists established a style early, the non-artist might change his style throughout. The artist also varied the activity within the picture while the non-artist did not.

On the basis of their results Eindhoven and Vinacke draw the following inferences: (1) artists have more control over their creative processes than do non-artists.

(2) Artists "appear to acquire a pattern of dealing with creative

situations which differs from that of non-artists."

(3) Artists tend to evolve a final product. They start by experimenting and gradually concentrate on certain features that are selected, modified and reorganized.

Finally, the authors conclude that there are no stages of the creative process but rather what is regarded as stages is really aspects of the creative process and they say, "Thus creativity might be thought of as one whole process consisting of all the various aspects participating concurrently."

Another approach to understanding the problem-solving process characteristics associated with creativity is that of Blatt and Stein (1959) which is based on Gestalt theory. These investigators start with the idea that a complex logical problem is composed of a universe of homogeneous elements that have to be combined into one or more series of relationships which need to be coordinated before the solution is attained. In some problems, as in the one to be described later, some of the relationships are "given" and others need to be learned. The subject arrives at these latter relationships by analyzing their constituent elements. Theoretically, once the subject has attained all the necessary and sufficient information, the problem can be solved in a single coordinating step. At this point the subject's behavior changes from the analysis of constituent elements to the synthesis of information at his disposal. Consequently, the problem-solving process may be described as consisting of two major phases--an analysis phase and a synthesis phase. Ideally, the shift from analysis to synthesis occurs when the subject has been exposed to all the necessary and sufficient information for solving the problem. In an actual situation, however, mere exposure to various elements does not mean that the subject understood their significance. The shift from analysis to synthesis therefore occurs usually some time after all the necessary and sufficient information has been attained. Consequently, the analysis phase may be said to be composed of an initial phase and a lag phase. The initial phase extends from the beginning of the problem-solving process to that point at which the subject has been exposed to the necessary and sufficient information. It is followed by the lag phase which is concluded when the subject's predominant mode of activity shifts from analysis to synthesis. In the synthesis phase the subject is said to be primarily concerned with coordinating obtained information. Using this model of the problem-solving process it may be said that efficiency in problem-solving may be defined as the absence of unnecessary questions.

To investigate the problem-solving of Ph.D. chemists engaged in industrial research activities Blatt and Stein used an apparatus developed by John and Rimoldi (John, 1957). This is an electro-mechanical apparatus in which the subject is presented with a series of logical relationships which he must derive and then coordinate. A center light is to be activated by pressing a correct sequence of buttons that surround it. The sequence of buttons actually pressed in arriving at the solution is automatically recorded on tape so that a complete protocol of the problem-solving behavior is available.

Seventeen Ph.D. research chemists employed in one industrial research organization were studied with this apparatus. The criterion of creativity was ratings obtained from superiors, peers and subordinates. Eight of the subjects were regarded as more creative and nine were regarded as less creative. Each subject was presented with a practice problem and this was followed with the experimental problem. One-half hour to one hour was required for the instructions and the practice problem. The experimental problem usually also required about an hour and due to its complexity subjects were permitted to make notes. Analysis of these notes indicated that they served primarily as a "memory" and they were not included in the analysis of the results.

The protocols, that is, the automatic tape-recorded sequences of the subjects' button presses were analyzed in terms of a variety of variables and the results indicated that solution of the problem did not differentiate between the more and less creative subjects but analysis of the process did. The more creative men tend to be more efficient (i.e., they tend to ask fewer unnecessary questions) and they tend to ask their questions at a slower rate. They also have a clearer A-S shift point, and tend to have a larger proportion of unique to redundant questions. Finally, they also ask a larger proportion of their questions in the initial phase, but they do not differ significantly from their less creative colleagues in the lag and synthesis phases.

Test or Experimental Approaches

Welch (1946) describes a test for measuring the ability to "recombine ideas according to a plan." The test consists of four parts: In Part I the subject is given 10 groups of words and is asked to make one or more complete, grammatical and meaningful sentences out of as many groups as possible in 10 minutes. Part II requires the subject to make as many letters as possible out of three straight lines, two straight lines, and one straight and one semicircular line in three minutes; Part III consists of 20 unrelated words and the subject is required to invent a story using each of the 20 words in order in 3 minutes; Part IV consists of five series of 10 blocks which are presented to the subject, one series every two minutes, and he is required to make as many recognizable pieces of furniture he can think of in each two-minute period allotted.

Forty-eight college students and 30 professional artists were studied with the test. The correlation with age was insignificant but the professional group scored significantly higher than the college group. For five of the commercial artists company ratings on creativity were available and there was high agreement between these ratings and the test scores. Of the four parts of the test only the second and fourth differentiated significantly between artists and non-artists.

The same test was administered by Fisichelli and Welch (1947) to 30 professional artists, 25 female art majors and 48 unselected students. Total scores for professional artists and art majors did not differ, both did differ significantly from the unselected students. This finding was most clear on Parts II and IV of the test whereas Parts I and III, which require literary constructions, were least discriminating. Test performance of the art majores correlated .45 with a general scholastic index although the art majors did not differ significantly from the unselected students in performance on the ACE. A correlation of .27 between test performance and the Wonderlic Personnel Test was also obtained.

In an effort to obtain "an indication of a person's ability to produce a quantity of unique ideas in a given situation" Harris and Simberg (no date) constructed a test that consists of five parts: Part I is a 20-minute test in which the subject lists the consequences to common situations. Part II is a 10-minute test of general reasoning. Part III is a 15-minute test of sensitivity to problems. Part IV is a 20-minute test of practical judgment and Part V is a 15-minute test of originality. Three types of scores are obtained with this test--quantity, quality and uniqueness.

Using this test at the AC Spark Plug Division of General Motors Corporation the following results have been obtained: (1) the total test and seven sub-scales differentiated at the .05 level or better between two groups of 18 each at General Motors who were separated in terms of supervisors' ratings on quantity of unique ideas. (2) The total test scale and all sub-parts differentiated significantly between engineers whose overall performance on creative tasks was rated satisfactory or unsatisfactory by their supervisors. (3) Combined quantity scores differentiated between matched pairs of hourly employees who were differentiated in terms of number of suggestions submitted to the company's Suggestion Plan. (4) Only two sub-test scores differentiated between engineers who spent more than 50 per cent of their time on developmental work and whose supervisor said had demonstrated ingenuity, inventiveness, plus many ideas from a group of engineers who spent less than 30 per cent of their time in developmental work. (5) Significant differences were obtained between engineering students who received A's and B's in a course on product design. Students who received higher instructor ratings also received higher test scores.

A reliability coefficient of .92 using the Kuder-Richardson formula is reported. Two forms of the test exist and they intercorrelate .75. The total score and five sub-test scores intercorrelate in the .30's and .50's with the mental alertness score of the Wonderlic Personnel Test. College graduates score higher than non-college graduates on the test and the test is also correlated with Thurstone temperament scores (active, vigorous and dominant) and the Kuder literary score. Overall job performance ratings on 165 engineers were related to total score and when the middle group was left out a difference, significant at the .01 level, was obtained. No significant relationships between total test score and length of service in the company were obtained.

"A Test of Productive Thinking" has been developed by Bennett and Wesman (1949). This test consists of six hypothetical situations outside the range of the subject's experience and he is asked to give consequences. Ten minutes are allowed for each problem and responses are scored for quality which depends on originality and scope of response rather than scientific accuracy. Split-half reliabilities from several groups ranged about .9.

Taylor (1958) studied electronic engineers and electronic scientists who were rated on creativity and productivity by supervisors and non-supervisors and found that the Strong Engineering Scale and the Terman Concept Mastery Test did not yield significant correlations with the criterion. However, significant correlations were obtained with the Test of Productive Thinking.

Flanagan (1957) describes a test of "ingenuity" which he defines as follows: "Ingenuity involves indicating or discovering a solution to a problem. Here the emphasis is on the recognition of the existence of a problem and the display of an ingenious quality in being able to offer a neat, clever, or surprising solution " (Flanagan, 1959). It is more narrowly defined than productivity or creativity. For Flanagan, "Productivity involves bringing forth many ideas and solutions to problems emphasizing both quantity and contribution." And, "Creativity involves working something new into being. The emphasis here is on the newness of the idea or product, something which did not previously exist " (Flanagan, 1959).

The test consists of 24 items in which a problem is stated and the ingenious solution is to be found in a series of choices in which only the first and last letters in the key words are given. In one validity study based on 50 members of American Institute for Research staff the test correlated .30 with peer ratings of ingenuity (Flanagan, 1957). Concurrent validities in other studies have also been reported (Flanagan, 1959). In these the range of correlations between course grades and the ingenuity test for 9th and 12th grade pupils is from .32 to .42; the correlation between the test and total high school grade average for a rural high school was .61, in high school art classes (where the criteria were project ratings and general ratings) the correlation ranged from .40 to .58, in high school English classes (with similar criteria) the correlations ranged from .33 to .54, and with scores from Part III of the Cooperative Plan Geometry Test, Form X, correlations ranged from -.01 to .44.

Jex (1959) used the Ingenuity Test with 54 secondary school teachers of mathematics and science and found a correlation of -.19 between ingenuity scores and the average of two or three principal-supervisor ratings of each teacher's ability and effectiveness.

Owens, Schumacher and Clark (1958) studied engineers who were regarded as creative and non-creative in their companies. Nine tests were administered to these subjects a portion of whom were used for item analysis and a portion of whom were used for cross-validation. In addition to Personal Inventory and Personal History questionnaires two tests survived the item analysis. These were: a Power Source Apparatus Test in which the subject is given a power source and a motion sequence and is asked to sketch as many intervening mechanisms as he can and an Application of

Mechanisms Test. The authors suggest that by using a discriminant function the accuracy of future predictions in the company would fall between 66 per cent and 88 per cent.

It is apparent from the review of research on thinking and problem-solving that it is characterized by a variety of theoretical orientations and approaches. When significant differences are reported between groups, they appear to be consistent with other data and also make intuitive sense. However, there are several instances where replication has not supported earlier results and one is at a loss for a well-defined rationale. To be sure, it is not difficult to suggest reasons why results have not been replicated--differences in criteria, differences in subjects, etc. But these are only possibilities. They require further investigation so that we might learn more about the conditions under which certain tests or factors do or do not differentiate between subjects and the circumstances under which certain characteristics are important.

When it is hypothesized that the creative individual differs from others in the unusualness and adaptiveness of his responses, or when it is hypothesized that he differs in terms of process characteristics and the like, it must be borne in mind that thought processes and problem-solving characteristics do not represent all there is to know about the creative individual. He is a combination of both intellectual and non-intellectual factors, personality and cognitive characteristics. Consequently, when low or relatively moderate correlations are obtained between tests developed in the laboratory and some criterion of creativity for individuals who are manifestly creative in real situations it is likely that the residual variance may be accounted for by personality and social factors that require further investigation .

Our survey of the research in this area has indicated that several interesting and valuable approaches to the study of thinking and problem-solving and creativity do exist. What is now also indicated is further exploration with these tests and techniques in both laboratory situations and in the real social environment, their utilization with individuals who are regarded as creative in a variety of scientific and professional areas, and the study of their relative value when several of the techniques are used with the same population in the same study.

Chapter III

Personality Factors

Almost from time immemorial man has tried to understand what motivates the creative individual to create and what it is that distinguishes him from other individuals. Is he divinely inspired? Does he have a muse? Or does he possess some constellation of psychological characteristics that predispose him to creative activities?

Answers to these questions are numerous. As one might guess they have varied with the Zeitgeist, the philosophical, sociological or psychological orientations of the times. When man's behavior was believed to be affected by unknown external forces, spirits, demons, and the devil, his creativity was accounted for either by the belief that he was possessed or that he had in some way obtained magical powers. Those investigators who regarded biological and physiological factors as most critical in shaping individual differences turned to hereditary and constitutional factors to learn about the mainsprings of creativity. When psychoanalysis came on the scene, studies of the creative individual emphasized the unconscious, psychosexual factors, sublimation, etc. And, as psychoanalytic theory underwent revision so were views of the creative man altered.

Among the psychological studies of the creative individual, "Everything that might be regarded in one way or another as important in a study of any individual--his heredity, his childhood, his adolescence, his adult personality, his intelligence, his perceptual processes, his problem-solving behavior, etc.--has been considered in some study of the creative individual" (Stein and Heinze, 1960).

The results have been rather varied. One person or another has argued for the importance of pregenital drives, defense mechanisms, defenses against defenses, insanity, sanity, or the importance of self-actualization. There are those who believe that creativity or creative potential exists in each of us and that some personality factors may block its manifestation. There are others who insist that there are few among us who are "truly" creative.

Our purpose is to present empirical psychological research in this area. Although a discussion of theory is beyond the scope of this review, it is well to indicate that current theories fall into three major categories: (1) Creativity is seen as a drive and involves theories of self-actualization, integration and competence; (2) Creativity is seen as the sublimation of impulses; (3) Creativity is seen as a means of restituting for destructive impulses. Summaries of papers devoted to these issues may be found in Creativity and the Individual (Stein and Heinze,1960).

The empirical psychological studies of the personality characteristics associated with creativity will be presented according to the criterion employed. In this manner, it is hoped that some confusion will be avoided. At the same time, some similarities and differences will become apparent.

The first category of studies will include those in which the investigator used a psychometric or psychological definition of creativity. Individuals were selected in terms of test scores and then their personality characteristics were studied.

The other categories include those studies in which subjects were regarded as manifestly creative in real life situations. In one, subjects were selected in terms of a productivity criterion and in the other, subjects were selected in terms of expert judgments. The latter category is further sub-divided into one category in which only creative individuals were studied and in the other creative individuals are compared with other individuals.

Psychometric Criteria

Probably the best illustration of the approach in which psychological and statistical criteria have been utilized for differentiating between groups is that reported by Barron. Barron's work is part of the overall group of studies conducted at the Institute of Personality Assessment and Research (IPAR) at the University of California at Berkeley. In this program subjects spend several days together being tested and interviewed by staff personnel. Tests include objective, projective and situational tests. Subjects in this program may also be selected in terms of expert judgment but the studies presented here are based on psychometric criteria.

In 1955 Barron reported a study in which he investigated the personality characteristics of 15 "original" and 15 "unoriginal" Air Force Captains. These 30 came from a larger group of 100 who, as a group, are described as normal, healthy men of average intelligence, and of lower-middle class status in their pre-military life. The criterion of originality was the infrequency but adaptiveness of responses to the following psychological tests: Guilford's tests of Unusual Uses, Consequences B, and Plot Titles B. For the Rorschach, 0+ scores were used and for the TAT an originality score was also developed. Two additional tests were also used: an anagrams test, and a word rearrangement test.

The "original" group of subjects was that group that scored at least one standard deviation above the mean on a composite originality score and two standard deviations above on at least one of the component tests.

The subjects who fell into this group were then compared with a group of 15 who were the lowest scoring individuals.

For both groups the following procedures were used: Barron-Welsh Art Scale, psychiatric interview, Crutchfield's modification of the Asch experiment, psychodrama, the California Personality Inventory (only the social dominance and impulsivity scales were used), Krout Personal Preference Scale (only the phallicism, and early and late anal scales were used), staff observations, an index of suppression-expression based on the MMPI and the Policeman Interest Scale of the Strong Vocational Interest Blank.

The following characteristics differentiated the original from the unoriginal groups. The former preferred complexity and some degree of imbalance in phenomena. They are more complex psycho-dynamically and have greater personal scope. They are more independent in their judgments. They are more self-assertive and dominant and they reject suppression as a mechanism for controlling impulses.

In a later study (Barron, 1957) he used an approach similar to the one described above for selecting one group of 25 original men that he was able to compare with another group of 25 unoriginal men. In this study Barron utilized a 76-item Q-sort and a 300-item adjective check list to collate information obtained from psychological tests and the observations of staff members at IPAR. Using this procedure Barron found that the original group was described as follows: intelligent, widely informed, concerned with basic problems, clever and imaginative, socially effective and personally dominant, verbally fluent and possessed of initiative. The unoriginal group, on the other hand, was described as conforming, rigid and stereotyped, uninsightful, commonplace, apathetic and dull.

Because of an apparent relationship between verbal fluency or intelligence and traits described above, a second study was undertaken and reported in the same paper (Barron, 1957). In this study the Terman Concept Mastery Test was used to partial out intelligence. The procedures used to gather data on subjects' personalities were the same as those described above and the results here indicated that the "originals" were different from the "unoriginals" in that the former had a disposition toward integration of diverse stimuli, energy, fluent output and movement; personal dominance and self-assertion; responsiveness to impulse and emotion; femininity of interests; and general effectiveness of performance.

Productivity as a Criterion

Rossman (1931) submitted a questionnaire to 710 inventors who had, on the average, 39.3 patents each. The results indicated that the inventor might be characterized by "constructive criticism" toward deficiencies in his environment, ability to recognize deficiencies, persistence of motive and effort to overcome deficiencies. In a sense he is much like other successful people but often not too good a business man.

Van Zelst and Kerr (1951) administered a questionnaire to 194 faculty and scientific personnel at the Illinois Institute of Technology and the Armour Research Foundation. They divided this population into high and low productivity groups using as an index of productivity the number of publications and five times the number of inventions. Analysis of the questionnaire responses indicated that the more productive ones were less equalitarian in practice in their research units, have more belief in the self-determination of deadlines and more selflessness of motive than do the less productive ones. In a later study (Van Zelst and Kerr, 1954) the authors gave their subjects, 514 technical and scientific personnel at IIT and Armour Research Foundation, a self-rating scale of 56 traits based on Cattell's research. Each subject was to rate himself on a 5-point rating scale and these data were correlated (with the effects of age partialled out) with the same index of productivity described above. In this study it was found that the more productive men described themselves as: more original, less contented, less conventional, more imaginative, more curious, more enthusiastic, more impulsive, more self-confident, more leading, less worrying, less inhibited, less formal, more liking for work, more subjective, more fastidious and less acquisitive than the less productive subjects.

Expert Judgments--Creative Individuals Alone

One of the pioneering efforts in the study of creativity is the series of studies published by Anne Roe. Her subjects were leading painters or psychologists, anthropologists, biologists and physical scientists. These groups were studied with the Rorschach, TAT, a specially constructed verbal, spatial and mathematical test (VSM) and an interview.

In her study of painters Roe (1946b) found no single personality pattern in either the Rorschach or TAT and no criteria could be established for the capacity to be a successful artist. However, evidence was found for the lack of masculine aggressiveness. Another report on the same group (Roe, 1946a) indicates the importance of manual skill, energy output, perseverance, and sufficient evidence to assume "aesthetic intelligence" and "aesthetic judgment." The subjects were also regarded as possessing a tendency toward abstract thinking, an emotional adaptation that was rather passive, self-discipline and a capacity for hard work.

Unaggressive behavior was also revealed in the study of biologists (Roe, 1949) but nevertheless they are persistent and stubborn in what they do (Roe, 1951a). The biologists are also described as having very little interest in interpersonal relations. Although their interpersonal relations lack warmth they are superficially smooth (Roe, 1951a). The biologists are also described as having a slow and restricted psychosexual development, a tendency to avoid emotional and interpersonal relations. They were unwilling to go beyond the data, had a distaste for the imaginary and strong preference for concrete details. They were rather conventional with a strong sense of responsibility (Roe, 1949).

In view of the fact that different professional groups were studied it was also possible for Roe to compare them. On the TAT she found (Roe, 1953) that psychologists give a higher incidence of unhappy, tense and anxious tones than do the anthropologists who have recourse to the melodramatic and sardonic. For both the psychologists and anthropologists interpersonal relations are more frequently formal than emotional. The most frequent theme in TAT stories was the theme of general helplessness in the face of severe problems. There is evidence for dependence on parent figures and stories of rebellion followed by guilt and unhappiness.

On the TAT biologists and physicists were less interested in interpersonal relations and more inclined to handle them in "distance-getting" ways than social scientists who reflected concern over sure relations but not dislike. The biologists were restrained in the expression of aggression and the social scientists freest in this.

On the Rorschach the subjects showed evidence of general productiveness, ability to be rational or not as they wished. Most of the subjects showed fairly free aggression which was clearer and stronger among the anthropologists and obviously oral among the psychologists. It was fairly common to find conflict over dominance and authority and particularly psychologists gave evidence for the need to hold and feel nurturant attitudes.

The Rorschach records of the eminent subjects were compared with those obtained from those not regarded as eminent and the former were found to be more productive, more original and less controlled. They showed greater productivity and reactivity and more originality and less control.

By way of summary Roe points out that her data show intellectualization of interests, importance of need to achieve and maintain independence, and a feeling of separateness from others. Although the groups may not be regarded as well adjusted by psychological definition, most were well adjusted in the broader sense of being socially useful and happy in their work.

Architects were studied at IPAR and a report of this research by MacKinnon (1959b) indicated the following: In terms of values the architects were highest on the esthetic value, followed closely by the theoretical value. Their lowest value was the economic value. In holding highly developed esthetic and theoretical values the architects manifest a capacity to tolerate tension generated by strong values and probably seek the reconciliation of these values in their work. They also give freer expression to feminine characteristics than do less creative persons. They show openness to feelings and emotions, understanding, self-awareness, and wide-ranging interests which in our society are regarded as feminine. The majority of them were introverts and they do not want much social interaction but when it occurs they prefer to initiate it rather than to receive it.

In another study reported by MacKinnon (1959a) Jung's system of personality types was used to differentiate between various groups of creative individuals. To gather data on the personality types the Myers-Briggs Type Indicator (Briggs and Myers, 1957) was used and the following results obtained:

On Judgment vs. Perception: -- 80 per cent of the writers were perceptive, only 20 per cent were judgmental. For mathematicians the preference was reversed: 30 per cent were perceptive and 70 per cent judgmental. Industrial researchers show a more even distribution between judgment and perception.

Sensation vs. Intuition -- 93 per cent of the writers, 90 per cent of the mathematicians and 89 per cent of the industrial researchers were intuitive. All these figures contrast markedly with the fact that of the general population only 25 per cent are intuitive.

Thinking vs. Feeling -- writers prefer feeling to thinking, mathematicians prefer thinking rather than feeling.

Extraversion vs. Introversion -- writers, mathematicians and industrial researchers were all inclined to introversion but not to the same degree. Among writers there are almost as many extraverts as introverts: 47 per cent extraverts and 53 per cent introverts. Mathematicians were most extreme on introversion: 80 per cent introverts as against 20 per cent extraverts. Among the industrial researchers it was found that 62 per cent were introverts and 38 per cent extraverts.

In terms of model types the writers were "a perceptive type combining introverted feeling with extraverted intuition." The industrial researchers were "a perceptive type combining introverted thinking with extraverted intuition." And, the mathematicians were "a judging type combining introverted intuition with extraverted thinking."

Peck (1958) reports the results of his experiences with engineers who had already demonstrated original inventiveness of a high order. These were individuals who were studied in a series of investigations over a period of time at the University of Texas and the University of Chicago. The methods used in the studies are not indicated; nevertheless, Peck summarizes his findings as follows: They have a distinct drive to be creative, a desire to be different, desire to prove their ideas are superior. They have unusual persistence and an "autonomous, intrinsic, motivating urge, of a kind that cannot be summoned up by the desires, or even orders, of other people." The boundaries between their conscious and unconscious is permeable and this gives an "extra charge" and "vitality" to their work.

While the above studies have all been based on living subjects the characteristics of eminent men who are described in biographies have also been investigated. Shannon (1947) studied world renowned research workers (natural scientists, mathematicians, inventors, medical scientists, and social scientists) as described in 46 biographies. The traits mentioned in the biographies were checked against a master list of 46 trait names or families. For over half the men the following traits were used: enthusiasm, intelligence, versatility and symbol-thinking, creativeness, expertise, aggressiveness, dissatisfaction, industriousness, perseverance, concentration, thoroughness, alertness, curiousity and ambition. White (1931) also found versatility to be characteristic of eminent men.

Expert Judgments - Comparisons Between Individuals Who Vary in Creativity

When studies of creativity are limited to creative individuals it is apparent that we have no way of knowing to what extent the obtained characteristics are not also present in other individuals who are in the same area of work --consequently, the value of comparing individuals who vary in creativity.

Irmgard Andersen and Ruth Munroe (1948) present a study in which they compared 20 female college students who concentrated in creative painting and who were regarded as "moderately or genuinely gifted" with 20 female college students who had training in composition and design and were regarded as "promising" but as lacking in "truly creative power." A third group of 40 college students majoring in liberal arts courses was used as a control group. The authors used the Group Rorschach scored according to Munroe. No statistically significant differences were obtained between the painting and design students possibly because of the small numbers of subjects studied. When the painting and design students were combined and compared with the control group again no differences appeared. It was only when the painting group alone and the design group alone were compared with the control group that differences did emerge. On the basis of this comparison the authors describe the painting students as tending to be "highly idiosyncratic in their evaluation of reality," emotionally responsive to social stimuli, and possibly they live out their aggressions in their creative work.

By contrast the design students are described as practical, objective, somewhat conventional, they fear their affect and spontaneity which results in aggressive feelings and behavior. Their work gives them an opportunity to deal objectively with definite material but does not serve to relieve tension. Finally, it should be pointed out that the authors did not find any similarity between their students' Rorschach protocols and those obtained by Roe (1946a, 1946b, 1946c) in her study of artists.

Elizabeth Munsterberg and Mussen (1953) also studied art students. They selected 30 art students who were regarded as outstanding by their faculty and compared them with 30 non-art majors who were equated with the first group for age, sex, and year of college attendance. They used 10 TAT cards and a questionnaire to obtain information on the students' interest and participation in artistic activities. With these techniques the artists were found to be quiet, introverted, and to suffer from intense guilt feelings. They were also found to be less likely to show overt aggressive tendencies. They desire more to have approval of their work than personal acceptance.

By contrast the non-artists were willing to submit to parental domination and society's demands to achieve personal success, material comfort and social approval.

Biologists, physicists and psychologists were studied by Cattell and Drevdahl (1955). Their subjects were selected by committees from rosters of professional societies. The subjects were divided into three groups. One consisted of those who were noted for their research contributions and the other two were known for their teaching and administration. The last two groups were also low on their research contributions. All subjects were studied with the Cattell 16 PF test. A comparison between the scientists and teachers and administrators revealed that the scientists were more: schizothyme, self-sufficient, emotionally unstable, bohemianly unconcerned and radical. Less uniformly they were: more dominant, paranoid, withdrawn schizothyme, lower on compulsive super-ego. Cattell and Drevdahl conclude their study by integrating their data and saying that "the schizothymic preoccupation with things and ideas rather than people; the self-sufficiency which favours creativity and independence of mind;

the dominance which gives satisfaction in mastery of nature for its own sake; and the emotional instability which permits radical re-structuring and creativity, would all be vital to the best kind of basic research performance, though perhaps unpleasant in an administrator and inapt in a business man. The remaining factor of Bohemian unconcern and radicalism may perhaps best be regarded as condition and consequence of continued adjustment to the researcher's comparative earnings."

Drevdahl (1956) studied graduate and advanced undergraduate students in science and art. These students had been rated by their faculty on a seven-point scale of creativity and the entire population was divided at the 50th percentile and the upper and lower halves compared on the Cattell 16 PF test. The only differences obtained were that the more creative subjects were higher on radicalism and self-sufficiency but lower on cyclothymia and surgency than the less creative subjects.

Drevdahl suggests that his study reveals minimal differences and that sharper differences might be obtained by using more highly loaded tests, utilization of subjects with demonstrated creativity and the use of upper and lower thirds rather than upper and lower halves.

Bloom (1956) reports a study of chemists and mathematicians. The creative group included one Nobel prize winner and almost all of them were starred men of science. They were selected by a panel of experts. The non-creative group was selected by the author and his coworkers as giving little evidence of creativity. These groups were studied with 27 unspecified tests "intended to measure fluency, originality, perseverance, etc." and several projective tests were administered only to the creative group. The author reports that his results were similar to those obtained by Roe (1952). His more creative subjects had tremendous energy that they channeled into research; many had some difficulty in establishing warm and friendly relations with other people. These creative subjects also showed a need to retreat from the social and personal world to the world of ideas and objects.

Industrial research chemists were studied by Stein (1956). All subjects had the Ph.D. They were divided into a group of "more" creative men and "less" creative men in terms of ratings obtained from their superiors, peers and colleagues. The men were studied with a specially constructed test of autonomy (based on theoretical developments in ego psychology), the Allport-Vernon-Lindzey Scale of Values and an adjective check list. A comparison of the more and less creative men indicated that the more creative were more autonomous, strive more for distant goals, have more integrative attitudes and see themselves as different from others. They are more cautious and realistic and more consistent in their desires for rewards. They also have a more differentiated value hierarchy and regard themselves as more assertive, authoritative and capable of leadership but less acquiescent and submissive than their less creative colleagues.

A later report by Blatt and Stein (1957) also concerned itself with Ph.D. industrial research chemists. The population in this study is smaller than the one reported above by Stein. In this study there were eight "more" and eight "less" creative men selected in terms of superiors', colleagues' and subordinates' ratings. Again a test of autonomy was used as was the Allport-Vernon-Lindzey Scale of Values. In this study it was again reported that the more creative men were more autonomous, striving and devoted. They saw their attitudes as more different from others and they had higher economic and aesthetic values but lower social, religious and authoritarian values than their colleagues.

Engineers who were engaged in industrial research who were differentiated on a factor of General Competence were studied by MacKinnon (1959a). Although previous studies at IPAR found that more creative persons are more independent in their judgments, the data on industrial researchers are not so clear since they vary from measure to measure. "Whether there is indeed a reversal of the usually observed positive relation between creativity and independence of thought and action among industrial researchers, which our data suggest but do not demonstrate, or no relationship, or actually a positive relationship, only future research can indicate." Also, while previous studies indicated a relationship between general competence and esthetic sensitivity and interests no such significant relationship was found for industrial researchers. The more competent men were, however, found to be better able to understand others and to make correct judgments about them. This skill is manifest more in the ability to diagnose and predict in specific situations rather than in the ability to make statements and predictions about people in general.

In terms of Jungian types, as indicated by the Myers-Briggs Type Indicator (Briggs and Myers, 1957) those researchers who showed a preference for feeling obtained a higher score than those who showed a preference for thinking. To account for this MacKinnon suggests that two factors may be involved. "Provided the thinking and feeling types are equally gifted intellectually, and equally possessed of technical skills, and equally able to think analytically and logically, then a strong preference for feeling may on the one hand, impart an enthusiasm and verve for research which would deny that difficulties and problems are insurmountable, and on the other hand, contribute to more feeling and understanding and appreciation of associates and friendlier and smoother relations with them, all of which might earn for the feeling types higher ratings on the criterion dimension of General Competence." And, "In addition, the feeling type would probably be more ready to play his hunches and the occasional 'long shot' which he could not defend logically but which his intitution tells him is the way to a solution. This sort of behavior, of course, makes for many 'failures,' but it also has accounted for many of the most brilliant innovations and technological advances."

In this paper MacKinnon (1959a) also speaks of two traits that distinguish the creative individual from less creative individuals in all studies of IPAR. They are:

"1. The creative person seldom fits the layman's stereotype of him. In our experience he is not the emotionally unstable, sloppy, loosejointed Bohemian. More often it is the unoriginal and uncreative person who appears to be artistic, clever, emotional; while we discover ourselves using such adjectives as deliberate, reserved, industrious and thorough to describe truly original and creative persons....

"2. Closely related to this observation is our finding that although both introverted and extroverted thinkers are to be found among creative persons, they tend as individuals to be self-assertive and dominant and possessed of a high level of energy...."

In summary, studies of personality factors associated with creativity have involved at least three major criteria: psychometric definitions, productive measures, and expert judgments. The techniques employed in the studies have included objective tests, projective tests, questionnaires and interviews. And, the subjects studied have come from a variety of fields - the arts, the biological, physical and social sciences, and engineering. There is a great deal of diversity. Although the field is relatively new and despite the fact that there is much diversity there are certain areas of agreement that one may discern. In presenting these areas of agreement, a good deal of liberty has been taken in grouping characteristics. Obviously the operations for gathering the basic data have been quite different and in this respect the characteristics are dissimilar. They are similar only in the sense that the investigators' conclusions leads one to believe that the psychodynamic factors in the characteristics described overlap. It must also be borne in mind that the attempt here is not to present a picture of the creative individual. Evidence is already available which indicates that there are significant differences between individuals working in different areas. Our attempt is merely to summarize in rather broad strokes the available evidence.

With these cautions in mind, the areas of overlap regarding the personality characteristics of the creative individual and some of the differences in the studies surveyed are:

1. Self-assertive, dominant, leading, initiative, aggressive, self-sufficient --Shannon (1947), Van Zelst and Kerr (1951), Barron (1955, 1957), Cattell and Drevdahl (1955), and MacKinnon (1959a).

2. Rejects repression, less inhibited, less formal, less conventional, bohemianly unconcerned, radical, low authoritarian values--Van Zelst and Kerr (1951), Barron (1955), Cattell and Drevdahl (1955), Drevdahl (1956), and Blatt and Stein (1957). However it was also pointed out by MacKinnon (1959a) that they are not "bohemian".

3. Persistence of motive, liking and capacity for work, self-discipline, perseverance, high energy output, thorough--Rossman (1931), Roe (1946a, 1949), Shannon (1947), Bloom (1956), Blatt and Stein (1957), Peck (1958), and MacKinnon (1959a).

4. Independence and autonomy--Roe (1953), Barron (1955), Stein (1956), Blatt and Stein (1957), and Peck (1958). Although independence has been an important factor in other groups studied MacKinnon (1959a) did not find it to differentiate between groups of industrial engineers.

5. Constructively critical, less contented, dissatisfied--Rossman (1931), Shannon (1947), and Van Zelst and Kerr (1951).

6. Widely informed, wide ranging interests, versatility--White (1931), Barron (1957), and MacKinnon (1959b).

7. Openness to feelings and emotions, feeling more important than thinking, more subjective, vitality, enthusiasm--Shannon (1947), Van Zelst and Kerr (1951), Peck (1958), and MacKinnon (1959a and 1959b).

8. Aesthetic intelligence, aesthetic judgment, high or higher aesthetic values--Roe (1946a, Blatt and Stein (1957) and MacKinnon (1959b). However, aesthetic sensitivity was not found to differentiate in MacKinnon's (1959a) groups of engineers.

9. Low economic values, poor business man--Rossman (1931), and MacKinnon (1959b). Blatt and Stein (1957), however, found that their more creative industrial research chemists did have higher economic values than their less creative colleagues.

10. Freer expression of what has been called feminine interests and lack of masculine aggressiveness--Roe (1946a, 1946b, 1946c), Munsterberg and Mussen (1953), Bloom (1956), Blatt and Stein (1957), and MacKinnon (1959a and 1959b).

11. Little interest in interpersonal relationships, do not want

much social interaction, introverted, lower on social values, reserved --Roe (1949), Munsterberg and Mussen (1953), Bloom (1956), Blatt and Stein (1957), and MacKinnon (1959a and 1959b).

12. Emotionally unstable but capable of using their instability effectively, not well adjusted by psychological definition but adjusted in broader sense of being socially useful and happy in work --Roe (1953) and Cattell and Drevdahl (1955). That creative individuals are not unstable has been suggested, however, by MacKinnon (1959a).

These then are personality characteristics of creative individuals that have been mentioned in two or more of the studies reviewed. As was said previously they are not to be regarded as characteristics of the creative person because they do not appear in all studies. The reasons for this may be twofold: either they actually were not present in the subjects studied or they were not found because investigators did not look for them or they could not be assessed with the available techniques. By the same token there may be instances where only one investigator may report a characteristic not found in other studies which may occur because of the nature of his specific population, the theoretical variables or specific variables he employed. Herein lies one of the problems in this area - the lack of agreement on a systematic set of personality characteristics. This problem confronts us not only in the area of creativity but in other areas of personality research as well.

A second problem in this area is that personality characteristics are, in a good many instances, related to individuals' behavior in known professional groups. That is, a good many of the studies are based on chemists, physicists, artists, etc. rather than on the structural aspects of the field in which they work. We do not yet have a good set of variables to define the structural aspects of the field but what I have in mind is whether the field deals with abstractions or whether it involves close scrutiny of details. Not all physicists deal with the same subject matter in the same way--witness the difference between theoretical and experimental physicists. Another dimension on which fields vary is the degree of freedom they allow an individual to explore his own interest areas. Presumably there may be greater freedom in the academic laboratory than in the industrial laboratory and presumably there is greater freedom for the artist or the scientist who works on his own than there is for the individual who works in a formal social organization. Creativity is a function of the transactional relationships between the individual and his environment. Subject matter does not completely define the environment. Possibly, as the dimensions of the environment are worked out, we may find that more meaningful relationships, which will integrate the data of several studies, will be obtained when psychological factors and these dimensions are investigated. Associated with this suggestion is that we need to know the conditions under which certain psychological characteristics differentiate between individuals and this holds true not only for the personality characteristics surveyed in this chapter but also for the psychological characteristics surveyed in the previous chapter.

Another area worthy of further investigation is the types of individuals who are and are not creative. The studies surveyed, with the exception of MacKinnon's work (1959a) in which he utilized Jung's typology, and Stein's (unpublished) approach using Q-analysis with Murray's needs, compare groups of individuals on single variables. But theoretically different constellations of personality characteristics may lead to the same end-state --the principle of equipotentiality. Creative individuals may share characteristics but they also differ from each other. One step toward getting at their uniqueness may be through transposed factor analysis or Q-analysis.

Finally it should be pointed out that there is a need for predictive studies. Most studies are based on known groups and utilize concurrent validities. One of the problems with such studies is that they do not take into account the feedback effect on the individual of having been creative (or less creative) or knowing or believing that he is regarded as a creative (or non-creative) individual. Are some of the characteristics previously described predispositions toward or effects of creative endeavors? Or is there some combination of the two? Long-term predictive studies may cast some light on these problems. If it were also possible to add to these studies periodic testing and study of the creative individual we might also be able to learn more about the various psychological characteristics associated with various aspects of the creative process.

Chapter IV

A View Toward the Future

Systematic empirical research by psychologists in the area of creativity is a relatively new undertaking. In its present "youthful" stage it is characterized by much exploration and diversity. If it is to achieve maturity, consideration might well be given to the possibility of a coordinated and cooperative research effort among problem-oriented researchers. Unless some such program is undertaken it is likely, judging from the history of other assessment areas, that the research of the future will continue to produce a proliferation of technique-oriented studies on diverse groups without any necessary increments in our understanding of the creative individual or in our ability to predict who those individuals will be who will make future creative contributions.

In the suggested program a group of investigators would be assembled for a period of years during which they would select groups of individuals in a variety of areas to be studied. These individuals would come from a variety of organizational settings and would be selected in terms of diverse criteria. To these groups of subjects the investigators would administer a core battery of tests that they would decide upon. This battery would include not only cognitive tests and measures of cognitive style and personality tests, but also autobiographical questionnaires and measures of the environment. In addition to the core battery, allowance would be made for "pet" ideas or tests that are congenial only to individual investigators.

While each investigator might concern himself only with some set of variables or some special problems, the pooling of information would help resolve many basic issues. Through the analysis of the pooled data it would be possible to gain further insight into the conditions under which certain variables are more critical than others. And, it would be possible to establish the basic parameters and dimensions that are most critical under a variety of circumstances. We would thus be further ahead in integrating results which presently appear rather diverse. For example, we might find, as was suggested previously that very high autonomy and independence is critical in those situations where the individual is provided with much freedom and in pioneering areas of work. On the other hand, in more restricted areas, autonomy, while important,may not be as critical as some other factor. By the same token we might find that different patterns of variables are related to different areas of work, different styles of creativity, and different aspects of the creative process.

If there is coordination between laboratory studies of creativity such as those in which subjects are selected in terms of psychometric criteria with studies of individuals who are manifestly creative in real life situations, we might gain further insight into the effects of social and institutional facters on the creative process. These effects would also become more salient in longitudinal studies as we concentrate on individuals whom we might expect to be creative in terms of psychological criteria early in life but who in adulthood do not live up to expectations. Hopefully, in these longitudinal studies attention would also be paid to individuals for whom there is little expectation for some of them may be "late bloomers" from whom we can learn a great deal.

It is also to be hoped that this cooperative endeavor would draw more heavily on theories and speculations about the creative individual than has been characteristic of the field to date wherein the emphasis is primarily on empiricism. In this regard the suggestions of psychoanalysts who have studied creative persons over extended periods of time (including occasions when the individual has and has not been creative) might well be helpful.

The coordinated research program suggested here may sound like an overwhelming undertaking but it attains more realistic dimensions when we look at what investigators like Roe, Guilford and his group, MacKinnon and Barron and their colleagues, have been able to do in their studies of various groups. To these models one would need to add consideration of environmental variables or what I have called the "conditions" of creativity to have a clearer picture of what I have in mind.

Might we not, through a coordinated cooperative effort such as I have sketched come closer to further understanding an aspect of human behavior which is so critical for the individual and society.

Bibliography

Agnew, M. The auditory imagery of great composers. Psychol. Monogr., 1922, 31, 268-278.

Andersen, Irmgard, & Munroe, Ruth. Personality factors involved in student concentration on creative painting and commercial art. Rorschach Res. Exch. & J. proj. Tech., 1948, 12, 141-154.

Barron, F. Complexity-simplicity as a personality dimension. J. abnorm. soc. Psychol., 1953, 48, 163-172.

Barron, F. The disposition towards originality. In C. W. Taylor (Ed.), The 1955 University of Utah research conference on the identification of creative scientific talent. Salt Lake City: Univer. of Utah Press, 1956, Pp. 156-170. Also in J. abnorm. soc. Psychol., 1955, 51, 478-485.

Barron, F. Originality in relation to personality and intellect. J. Pers., 1957, 25, 730-742.

Barron, F. The psychology of imagination. Scient. Amer., 1958, 199, 150-166.

Barron, F., & Welsh, G. S. Artistic perception as a possible factor in personality style: its measurement by a figure preference test. J. Psychol., 1952, 33, 199-203.

Bennett, G. K., & Wesman, A. G. A test of productive thinking. Amer. Psychol., 1949, 4, 282. (Abstract)

Blatt, S. J., & Stein, M. I. Some personality, value, and cognitive characteristics of the creative person. Amer. J. Psychol., 1957, 12, 406. (Abstract)

Blatt, S. J., & Stein, M. I. Efficiency in problem solving. J. Psychol., 1959, 48, 193-213.

Bloom, B. S. Report on creativity research at the University of Chicago. In C. W. Taylor (Ed.), The 1955 University of Utah research conference on the identification of creative scientific talent. Salt Lake City: Univer. of Utah Press, 1956. Pp. 182-194.

Briggs, Katherine C., & Myers, Isobel B. Myers-Briggs Type Indicator. Privately printed. 1957.

Brighouse, G. A study of aesthetic apperception. Psychol. Monogr., 1939a, 51, No. 5, 1-22.

Brighouse, G. Variability in preferences for simple forms. Psychol. Monogr. 1939b, 51, No. 5, 68-74.

Burks, Barbara S., Jensen, Dortha W., & Terman, L. M. The promise of youth: follow-up studies of a thousand gifted children. In L. M. Terman (Ed.), Genetic studies of genius, Vol. III. Stanford, Calif: Stanford Univer. Press, 1930. P. 508.

Castle, Cora Sutton. A statistical study of eminent women. *Columbia University contributions to philosophy and psychology*. Vol. XXII, No. 1. New York: Science Press, 1913. P. 90.

Cattell, J. McK. A statistical study of eminent men. *Popular Sci. Mon.*, 1903, *62*, 359-377.

Cattell, J. McK. A statistical study of American men of science: the selection of a group of one thousand scientific men. *Science*, 1906, New series, *24*, 658-665.

Cattell, R. B., & Drevdahl, J. E. A comparison of the personality profile (16 P.F.) of eminent researchers with that of eminent teachers and administrators and of the general population. *Brit. J. Psychol.*, 1955, *46*, 248-261.

Chorness, M. H. An interim report on creativity research. In C. W. Taylor (Ed.), *The 1955 University of Utah research conference on the identification of creative scientific talent*. Salt Lake City: Univer. of Utah Press, 1956. Pp. 132-153.

Clark, E. L. American men of letters, their nature and nurture. *Studies in history, economics and public law*, *72*, No. 1. New York: Columbia Univer. Press, 1916.

Cowell, H. The process of musical creation. *Amer. J. Psychol.*, 1926, *37*, 233-236.

Cox, Catharine M. The early mental traits of three hundred geniuses. In L. M. Terman (Ed.), *Genetic studies of genius*, *Vol. II*. Stanford, Calif.: Stanford Univer. Press, 1926. P. 842.

Craig, M., & Manis, M. Prediction of scores on the Remote Associates Test by size of response repertoire. Unpublished manuscript, 1960. (*Psychol. Rev.*, 1962, *69*, 229)

Crutchfield, R. Conformity and character. *Amer. Psychologist*, 1955, *10*, 191-198. (*Psychol. Rev.*, 1962, *69*, 229)

Dennis, W. Age and achievement: a critique. *J. Geront.*, 1956, *11*, 331-333.

Dennis, W. The age decrement in outstanding scientific contributions: fact or artifact? *Amer. Psychologist*, 1958, *13*, 457-460.

Drevdahl, J. E. Factors of importance for creativity. *J. clin. Psychol.*, 1956, *12*, 21-26.

Eindhoven, J. E., & Vinacke, W. E. Creative processes in painting. *J. gen. Psychol.*, 1952, *47*, 139-164.

Ellis, H. *A study of British genius*. London: Hurst and Blackett, 1904.

Fisichelli, V. R., & Welch, L. The ability of college art majors to recombine ideas in creative thinking. *J. appl. Psychol.*, 1947, *31*, 278-282.

Flanagan, J. C. The definition and measurement of ingenuity. In C. W. Taylor (Ed.), *The second (1957) University of Utah research conference on the identification of creative scientific talent.* Salt Lake City: Univer. of Utah Press, 1957. Pp. 109-118.

Flanagan, J. C. The relation of a new ingenuity measure to other variables. In C. W. Taylor (Ed.), *The third (1959) University of Utah research conference on the identification of creative scientific talent.* Salt Lake City: Univer. of Utah Press, 1959. Pp. 104-123.

Galton, F. *Hereditary genius*. New York: D. Appleton, 1870.

Galton, F. *English men of science, their nature and nurture*. London: Macmillan, 1874.

Getzels, J. W., & Jackson, P. W. *Creativity and intelligence*. New York: John Wiley & Sons, 1962.

Ghiselin, B. Ultimate criteria for two levels of creativity. In C. W. Taylor (Ed.), *The second (1957) University of Utah research conference on the identification of creative scientific talent*. Salt Lake City: Univer. of Utah Press, 1958. Pp. 141-155.

Guilford, J. P. The relation of intellectual factors to creative thinking in science. In C. W. Taylor (Ed.), *The 1955 University of Utah research conference on the identification of creative scientific talent*. Salt Lake City: Univer. of Utah Press, 1956. Pp. 69-95.

Guilford, J. P. Creative abilities in the arts. *Psychol. Rev.*, 1957, *64*, 110-118.

Guilford, J. P. Intellectual resources and their value as seen by scientists. In C. W. Taylor (Ed.), *The third (1959) University of Utah research conference on the identification of creative scientific talent*. Salt Lake City: Univer. of Utah Press, 1959a. Pp. 128-149.

Guilford, J. P. Traits of creativity. In H. H. Anderson (Ed.), *Creativity and its cultivation*. New York: Harper, 1959b. Pp. 142-161.

Hadamard, J. *An essay on the psychology of invention in the mathematical field*. Princeton: Princeton Univer. Press, 1945.

Harmon, L. R. The development of a criterion of scientific competence. In C. W. Taylor (Ed.), *The second (1957) University of Utah research conference on the identification of creative scientific talent.* Salt Lake City: Univer. of Utah Press, 1958. Pp. 82-97.

Harris, R. R., & Simberg, A. L. AC Test of Creative Ability, examiner's manual. Flint, Mich.: AC Spark Plug Division, General Motors Corp. (no date)

Holt, R. R. Manual for the scoring of primary process manifestations in Rorschach responses. (Draft 7) New York: Research Center for Mental Health, New York University, 1959. (Dittoed)

Holt, R. R., & Havel, Joan. A method for assessing primary and secondary process in the Rorschach. In Maria A. Rickers-Ovsiankena (Ed.), *Rorschach psychology*. New York: Wiley, 1960. Pp. 263-315.

Houston, J. P., & Mednick, S. A. Creativity and the need for novelty. *J. abnorm. soc. Psychol.*, in press. (*Psychol. Rev.*, 1962, *69*, 231)

Jex, F. B. Negative validities for two different ingenuity tests. In C. W. Taylor (Ed.), *The third (1959) University of Utah research conference on the identification of creative scientific talent*. Salt Lake City: Univer. of Utah Press, 1959. Pp. 124-127.

John, E. R. Contributions to the study of the problem-solving process. *Psychol. Monogr.*, 1957, *71*, No. 18. (*J. Psychol.*, 1959, *48*, 196)

Karp, S. A validity study of a measure of creativity. Senior honor thesis, Univer. of Michigan, 1960. (*Psychol. Rev.*, 1962, *69*, 229)

Kowalski, J. Attitudes and occupational interests of creative individuals. Senior honor thesis, Univer. of Michigan, 1960. (*Psychol. Rev.*, 1962, *69*, 228-229)

Kris, E. *Psychoanalytic explorations in art*. New York: International Univer. Press, 1952.

Lehman, H. C. *Age and achievement*. Princeton: Princeton Univer. Press, 1953.

MacKinnon, D. W. The creative worker in engineering. Paper presented at the Eleventh Annual Industrial Engineering Institute, University of California, Los Angeles, and the University of California, Berkeley, February 6-7, 1959a.

MacKinnon, D. W. On becoming an architect. *Architectural Record*. August 1959b.

MacKinnon, D. W. Nurturing creativity in the able student. A talk given to the Senior Workshop for Teachers of Secondary Gifted Classes, Oakland Public Schools, Calif. November 17, 1960.

McPherson, J. H. A proposal for establishing ultimate criteria for measuring creative output. In C. W. Taylor (Ed.), *The 1955 University of Utah research conference on the identification of creative scientific talent.* Salt Lake City: Univer. of Utah Press, 1956. Pp. 62-68.

Mednick, S. A. The associative basis of the creative process. *Psychol. Rev.*, 1962, *69*, 220-232.

Meer, B., & Stein, M. I. Measures of intelligence and creativity. *J. Psychol.*, 1955, *39*, 117-126.

Miller, B. A study of creativity in college students and teaching method types. Senior honor thesis, Univer. of Michigan, 1960. (*Psychol. Rev.*, 1962, *69*, 228)

Munsterberg, Elizabeth, & Mussen, P. H. The personality structures of art students. *J. Pers.*, 1953, *21*, 457-466.

Owens, W. A., Schumacher, C. F., & Clark, J. B. The measurement of creativity in machine design. In C. W. Taylor (Ed.), *The second (1957) research conference on the identification of creative scientific talent*. Salt Lake City: Univer. of Utah Press, 1958. Pp. 129-140.

Patrick, Catharine. Creative thought in poets. *Arch. Psychol.*, 1935, *26*, 1-74.

Patrick, Catharine. Creative thought in artists. *J. Psychol.*, 1937, *4*, 35-73.

Patrick, Catharine. Scientific thought. *J. Psychol.*, 1938, *5*, 55-83.

Patrick, Catharine. Whole and part relationships in creative thought. *Amer. J. Psychol.*, 1941, *54*, 128-131.

Peck, R. F. What makes a man creative? *Personnel*, 1958, *35*, 18-23.

Pine, F. Thematic drive content and creativity. *J. Pers.*, 1959, *27*, 136-151.

Pine, F., & Holt, R. R. Creativity and primary process. *J. abnorm. soc. Psychol.*, 1960, *61*, 370-379.

Rapaport, D. Toward a theory of thinking. In D. Rapaport (Ed.), *Organization and pathology of thought*. New York: Columbia Univer. Press, 1951. Pp. 689-730.

Roe, Anne. Artists and their work. *J. Pers.*, 1946a, *15*, 1-40.

Roe, Anne. Painting and personality. *Rorschach Res. Exch.*, 1946b, *10*, 86-100.

Roe, Anne. The personality of artists. *Educ. psychol. Measmt.*, 1946c, *6*, 401-408.

Roe, Anne. Psychological examinations of eminent biologists. *J. consult. Psychol.*, 1949, *13*, 225-246.

Roe, Anne. A psychological study of eminent biologists. *Psychol. Monogr.*, 1951a, *65*, No. 14, 68.

Roe, Anne. A study of imagery in research scientists. *J. Pers.*, 1951b, *19*, 459-470.

Roe, Anne. *The making of a scientist*. New York: Dodd, Mead, 1952.

Roe, Anne. A psychological study of eminent psychologists and anthropologists, and a comparison with biological and physical scientists. *Psychol. Monogr.*, 1953, *67*, No. 2, 55.

Rosen, J. C. The Barron-Welsh Art Scale as a predictor of originality and level of ability among artists. *J. appl. Psychol.*, 1955, *39*, 366-367.

Rossman, J. *The psychology of the inventor: a study of the patentee.* (new and rev. ed.) Washington, D. C.: Inventors Publishing Co., 1931.

Saunders, D. R. Some measures related to success and placement in basic engineering research and development. In C. W. Taylor (Ed.), *The 1955 University of Utah research conference on the identification of creative scientific talent*. Salt Lake City: Univer. of Utah Press, 1956. Pp. 23-41.

Shannon, J. R. Traits of research workers. *J. educ. Res.*, 1947, *40*, 513-521.

Stein, M. I. A transactional approach to creativity. In C. W. Taylor (Ed.), *The 1955 University of Utah research conference on the identification of creative scientific talent*. Salt Lake City: Univer. of Utah Press, 1956. Pp. 171-181.

Stein, M. I. *Explorations in creativity*. Unpublished manuscript.

Stein, M. I., & Heinze, Shirley J. *Creativity and the individual*. Glencoe, Ill.: The Free Press, 1960.

Stein, M. I., & Meer, B. Perceptual organization in a study of creativity. *J. Psychol.*, 1954, *37*, 39-43.

Stern, G. G., Stein, M. I., & Bloom, B. S. *Methods in personality assessment.* Glencoe, Ill.: The Free Press, 1956.

Taylor, D. W. Variables related to creativity and productivity among men in two research laboratories. In C. W. Taylor (Ed.), *The second (1957) University of Utah research conference on the identification of creative scientific talent.* Salt Lake City: Univer. of Utah Press, 1958. Pp. 20-54.

Terman, L. M. The intelligence quotient of Francis Galton in childhood. *Amer. J. Psychol.*, 1917, *28*, 209-215.

Terman, L. Mental and physical traits of a thousand gifted children. In L. Terman (Ed.), *Genetic studies of genius*, *Vol. I*. Stanford, Calif.: Stanford Univer. Press, 1925. P. 648.

Terman, L. M. The discovery and encouragement of exceptional talent. *Amer. Psychol.*, 1954a, *9*, 221-230.

Terman, L. M. Scientists and nonscientists in a group of 800 gifted men. *Psychol. Monogr.*, 1954b, *68*, 44.

Terman, L. M., & Oden, Melita H. The gifted child grows up. In L. M. Terman (Ed.), *Genetic studies of genius*, *Vol. IV*. Stanford, Calif.: Stanford Univer. Press, 1947. P. 448.

Torrance, E. P. Explorations in creative thinking in the early school years: a progress report. In C. W. Taylor (Ed.), The third (1959) University of Utah research conference on the identification of creative scientific talent. Salt Lake City: Univer. of Utah Press, 1959. Pp. 58-71.

Van Zelst, R. H., & Kerr, W. A. Some correlates of technical and scientific productivity. J. abnorm. soc. Psychol., 1951, 46, 470-475.

Van Zelst, R. H., & Kerr, W. A. Personality self-assessment of scientific and technical personnel. J. appl. Psychol., 1954, 38, 145-147.

Walker, D. E. The relationship between creativity and selected test behavior for chemists and mathematicians. Unpublished doctoral dissertation, Univer. of Chicago, 1955.

Wallas, G. The art of thought. New York: Harcourt Brace, 1926.

Welch, L. Recombination of ideas in creative thinking. J. appl. Psychol., 1946, 30, 638-643.

Wertheimer, M. Productive thinking. New York: Harper, 1945.

White, R. K. The versatility of genius. J. soc. Psychol., 1931, 2, 460-489.